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## ARTHUR HENRY REGINALD BULLER

FRED J. SEAVER

(WITH PORTRAIT)

In the death of A. H. Reginald Buller the Mycological Society of America has lost a charter member, a life member, and a loyal supporter. His loss will be felt not only by the Society, but by mycologists throughout the world. His life was so full that it would be impossible in the space available to even begin to enumerate his activities and list his publications. Perhaps it will serve our purpose to quote a brief biography prepared by one of his colleagues, G. R. Bisby, for *Nature* (154: 173. 1944):

"Arthur Henry Reginald Buller was born in Birmingham on August 19, 1874. His biological training included work at Mason College, Birmingham, at Leipzig, Munich, and (in 1900) at the Marine Biological Station, Naples. He then returned to Birmingham as lecturer in botany until, in 1904, he was appointed first professor of botany in the University of Manitoba.

"The young and booming city of Winnipeg delighted Prof. Buller, and the cold, bracing winters suited him. He entered with enthusiasm and energy upon his teaching, which at first included geology as well as botany. He prepared all his lectures and laboratory courses with great care, and transmitted something of his scientific spirit to his students. He did much, with the few other faculty members, to promote the growth of the young University.

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"At night during the long winters, and in any free time by day, he devoted himself to researches on the fungi. With painstaking, persistent care, and with much ingenuity in the use of simple apparatus, he sought out the details of such activities as the production, liberation, and dispersion of spores in *Coprinus* and other fungi. Few could lose themselves so completely in their work as he; but, since he never married and always lived at a hotel, the missing of a meal or a night's sleep disturbed no one.

"One of the attractions of the position at Manitoba was the long summer holiday which allowed him to spend three or four months each year at Birmingham, where he worked in the laboratories or library, or studied Nature in the woods and fields, commonly with his friend W. B. Grove. In later years he spent much of each holiday at Kew.

"Although Buller had published several papers in scientific journals, by 1909 he had enough material for a book to be entitled 'Researches on Fungi.' He submitted his manuscript to a society, but was told it could not be published unless it were reduced by about half. That, he considered, would be mutilation. He therefore published the book at his own expense—and later five more volumes even larger. Many mycologists and others have found this *magnum opus* not only of great scientific value, but also eminently readable. Other books included 'Essays on Wheat' and a 'Practical Botany' for students.

"On returning to Winnipeg each year about the end of September, he started his classes and then took advantage of the usually glorious Canadian autumns for a few mycological forays. Alone or with students, and later with members of the mycological colony which gathered at Winnipeg, he went for one or a few days into the primeval woods at Kenora or Minaki. He was a most stimulating leader of such excursions, for he knew not only the names but also the habits of the larger fungi and was always ready to spend an hour or two, even in heavy rain, to discover any new detail.

"Professor Buller gradually built up a strong department of botany and, though there was no graduate school for several years, he helped train a number of mycologists and other men of science

now prominent in Canada. He took great interest in the Dominion Laboratory of Plant Pathology, which began at Winnipeg in 1923. He was always ready to help any co-worker.

"Many honours came to him, including the presidency of the British Mycological Society, of the Botanical Society of America, and of the Royal Society of Canada. He was awarded the LL.D. by the Universities of Manitoba and of Saskatchewan, and a D.Sc. by Pennsylvania. He was elected a fellow of the Royal Society in 1929, and awarded a Royal Medal in 1937. His popularity as a lecturer increased through the years, and he was frequently chosen to give important lectures or lecture courses in Canada and the United States.

"Buller's interests were broad. He knew by sight most of the flowering plants of England and of Manitoba, and many of the birds. He read much, and had memorized long passages from Milton and Shakespeare. He amused himself by writing verse (some of his limericks have international fame), by playing the piano, by conversation—preferably regarding fungi, but with interest on any subject. He listed his recreations as 'billiards and crossing the Atlantic' and, though he found little time for the former, he made about sixty-five trans-Atlantic journeys (surely a record for a botanist). He had assumed, when he became professor emeritus at Manitoba in 1936, that his Atlantic crossings would end on an even number. However, the outbreak of war caught him at a congress in New York, so he returned to his researches at Winnipeg, varied with a number of lecture trips. In Winnipeg—which, after all, had been his main home for forty years—he developed a tumour on the brain which entailed weeks of hopeless struggle, and caused him worry because all his planned researches were not completed. He died on July 3, 1944, and is survived by a sister in London."

G. R. BISBY

## TWO NEW SPECIES OF THE TILLETIACEAE FROM ARGENTINA<sup>1</sup>

ELISA HIRSCHHORN<sup>2</sup>

(WITH 3 FIGURES)

### *Tilletia Phalaridis* sp. nov.

Soriis in ovariis, 2-2.5 mm. longis  $\times$  1 mm. latis. Spores auratis flavescentibus, globosis, subglobosis vel irregularibus, 24.5-26  $\mu$  diam.; episporis tuberculato, tuberculis irregularibus et conicis et echinulatis; membrana hyalina vestitis.

Hab. *Phalaris angusta* Nees. Rep. Argentina, Santa Fe, Instituto de Investigaciones Agrícolas, leg. P. R. Marco, in herb. L. R. Parodi No. 14737, type in herb. E. Hirschhorn No. 2005.

Attacking the inflorescence and developing at the expense of the ovaries, leaving the remainder of the plant intact. Sori sand-colored, oval, 1  $\times$  2-2.5 mm., fragile, covered by a cinnamon-colored membrane, prolonged at the apex to form a little apiculum.

Chlamydospores pale yellow, globose, sub-globose, or irregular, 24.5-26  $\mu$  in diameter; episporis very coarsely tuberculate, the tubercles irregularly conical, finely echinulate, concave at the apex, 3-4  $\times$  3.5-11  $\mu$  high; enveloped in a thin hyaline membrane which exceeds the diameter of the chlamydospore (FIG. 1, A and B).

Sterile cells hyaline or slightly yellowish, oval or globose 14  $\times$  17-18  $\mu$ ; episporis 3-3.5  $\mu$  thick, finely echinulate (FIG. 1, C and D).

*Obs. I.* The glumes almost entirely cover the sorus, which makes detection of the parasite difficult.

I have not been able to observe germination, even after many attempts with different treatments and different media.

<sup>1</sup> Published as Scientific Paper No. 605, College of Agriculture and Agricultural Experiment Stations, State College of Washington, Pullman, Washington.

<sup>2</sup> Assistant in Plant Pathology, State College of Washington, Pullman, Washington. Grateful acknowledgment is made to George W. Fisher for assistance in the preparation of the photography.



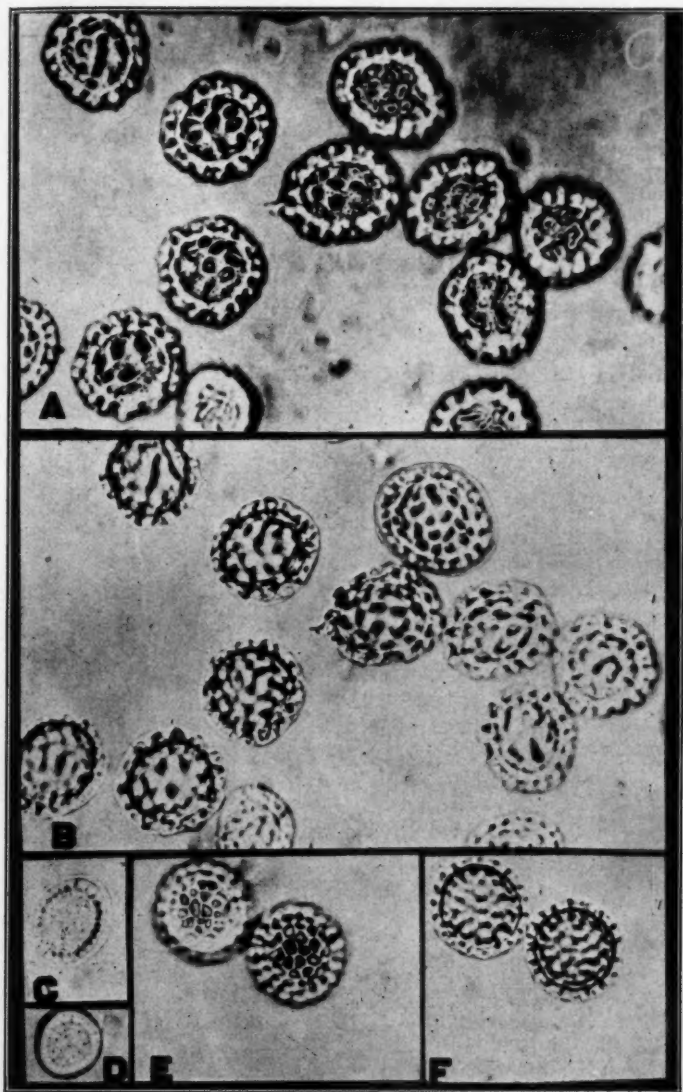


FIG. 1. A-D, *Tilletia Phalaridis*. A, photomicrograph of the chlamydo-spores, surface view; B, *ibid.*, same group of spores, median view; C and D, sterile cells; E, *Tilletia Menieri*, surface view; F, *ibid.*, same spores, in median view.

*Obs. II.* On *Phalaris colorata* (= *P. arundinacea* L.), in France, Harriot and Patouillard<sup>3</sup> described *Tilletia Menieri*. Study of the type material of this species<sup>4</sup> has proven it to be distinct from *T. Phalaridis*. The spores of *T. Menieri* are definitely reticulate and are not enveloped in a hyaline membrane (FIG. 1, E and F), as compared with *T. Phalaridis*, the spores of which are tuberculate and enveloped in a hyaline membrane (FIG. 1, A and B).

***Glomosporium Amaranthi* sp. nov.**

Sori in ovariis, colore cinnamommis, globosis, 1-1.5 mm. diam, compactis glomerulis auratis fuscis, globosis vel irregularibus, 60-89 $\mu$  diam., vel 70-143  $\times$  65-93  $\mu$  diam. Sporis colore cinnamommis vel auratis transparentibus, 12-17 $\mu$  diam. vel 12  $\times$  20 $\mu$  diam.; episporis verrucoso.

Hab. *Amaranthus* sp. Argentina: Salta, Oran. leg. *Hunsiker*, No. 2309.

Attacking the inflorescence and developing at the expense of the ovaries. Sori 1-1.5 mm. in diameter, globose, cinnamon-colored, slightly compact and granular; enveloped in a thin membrane (probably the epidermis of the ovary). Spore balls dark golden or very slightly orange, globose, 60-89  $\mu$  in diameter or irregularly elongated, 65-93  $\times$  70-143  $\mu$ .

Chlamydospores cinnamon-yellow, polygonal, 12-17  $\mu$  in diameter, or 12  $\times$  20  $\mu$ ; episporium thin, densely and prominently verrucose.

*Obs. I.* Paraffin sections of the sori and spore balls of *Glomosporium Amaranthi* have been studied. Figure 3 shows the appearance of the sorus in cross section. It is composed of the wall, which appears to be parasitized host tissue and almost a

<sup>3</sup> Harriot, P. and Patouillard, N. Description de Champignons nouveaux de l'Herbier du Museum. Bull. Soc. Myc. France 20: 61-65. 1904.

<sup>4</sup> Vestergren, Mycromycetes rariores selecti No. 1067.

FIG. 2. *Glomosporium leptideum* and *G. Amaranthi*. A, *G. leptideum*, group of spore balls, surface view; C, *ibid.*, same group of spore balls, median view; B, *ibid.*, reproduction of original illustration, median view; E, cross section of spore balls of *G. Amaranthi*, to show internal structure; F, spore balls of *G. Amaranthi*, surface view, same two spore balls as in lower right in D.

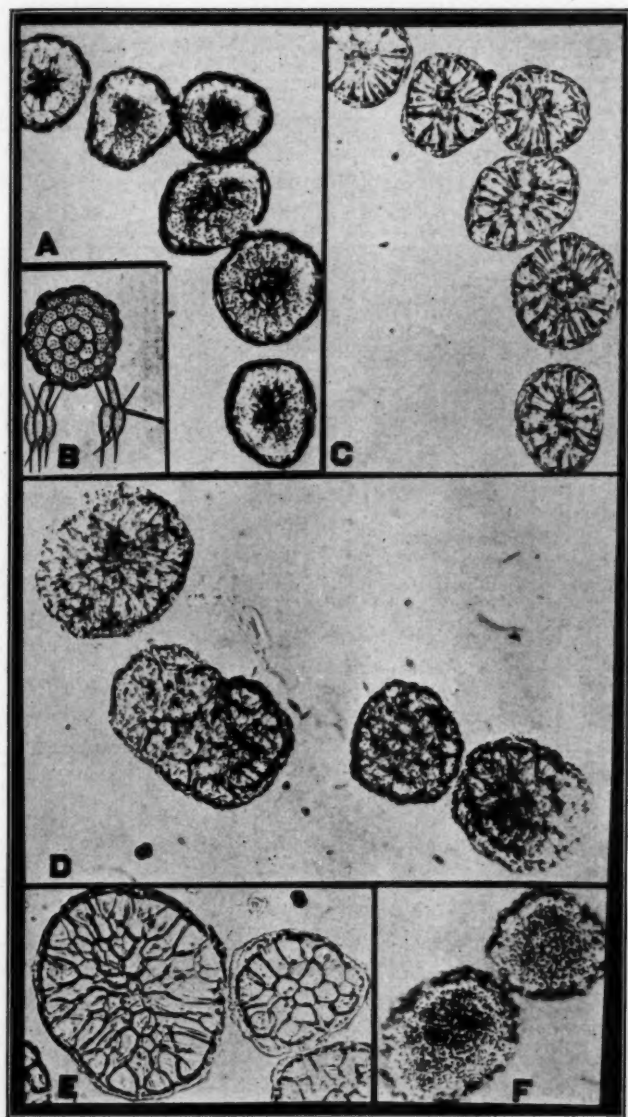


FIG. 2.

solid mass of spore balls. The spore balls themselves are solid in structure, and apparently are composed solely of spores, without central or peripheral cortex (FIG. 2, E).

*Obs. II.* Not all of the ovaries are attacked by the fungus, and the ones escaping produce apparently normal seeds.

The sori are so small and inconspicuous that they are difficult to detect.

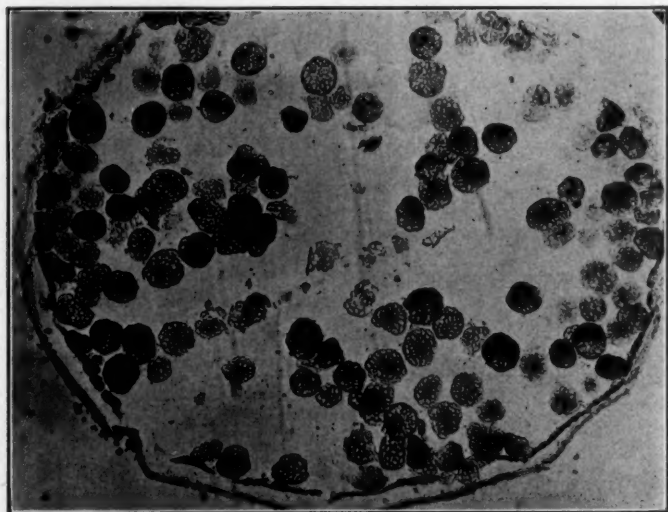


FIG. 3. *Glomosporium Amaranthi*, cross section of the sorus, to show structure and disposition of spore balls.

*Obs. III.* The genus *Glomosporium* was described by Kochman, according to Zundel,<sup>5</sup> in 1939, based on *Tolyposporium leptideum* Sydow which attacks *Chenopodium album* in Europe. The basis of Kochman's new genus of the Tilletiaceae is the character of the promycelium, which was found to bear a terminal cluster of 3-4 sporidia (FIG. 2, B).

*Glomosporium Amaranthi* differs from *G. leptideum* by its larger, darker, and more irregular spore balls, and by the more pronounced verruculations of the episporium (FIG. 2, A, C, D, F).

<sup>5</sup> Zundel, George L. Notes on the Ustilaginales of the world III. *Mycologia* 35: 164-184. 1943.

Until now, *Glomosporium* has been considered a mono-typic genus, with *G. leptideum* as the only species. A careful comparison of the smut on *Amaranthus* with type material<sup>a</sup> of *G. leptideum* leaves no doubt that two different entities are concerned. I have not been able to observe germination of the smut on *Amaranthus*, and for this reason it is provisionally assigned as a species of *Glomosporium*. The permanent smut balls also suggest the genus *Tolyposporium*. However, this genus is characterized by the spores being bound together by thickenings of their outer walls, to which character the smut on *Amaranthus* does not conform.

EXSICATTI EXAMINED: Germany: Forbach Lotharingiae, 9, 1913. Leg. A. Ludwig. Sydow *Ustilagineen* No. 475 (Typus of *Tolyposporium leptideum* Sydow) on *Chenopodium album* L.; Nahrpflanze, 27-8-14, Flora von Forbach in Lothringen, Herbarium A. Ludwig, on *C. album*: *ibid.*, 9-1913, leg. Dr. A. Ludwig. Dr. Zilligs *Ustilagineen* Herbarium, Typus of *Tecaphora leptideum* (Syd.) Zundel, on *C. album*; New South Wales Department of Agriculture, Biological branch, 1941, N. S. W., on *C. ambrosioides*; Moravia, 1-9-23, leg. Ed. Bandip, on *C. album*.

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PULLMAN, WASHINGTON

<sup>a</sup> Kindly supplied by Dr. G. L. Zundel.

## SPECIES OF SYNCHYTRIUM IN LOUISIANA

### I. DESCRIPTIONS OF SPECIES FOUND IN THE VICINITY OF BATON ROUGE

MELVILLE T. COOK

(WITH 4 FIGURES)

*Synchytrium*<sup>1</sup> is a genus of parasitic fungi belonging in the order Chytridiales and family Synchytriaceae. The individual fungus in all species consists of a single cell which lives the greater part of its life in an epidermal cell of a higher plant and in most species causes the formation of a gall or tumor. In the species reported in this paper the infections originate in the epidermal cells. These infected cells increase in size and either become surrounded by host cells which form the galls or become embedded as a result of the growth of the surrounding tissues.

The literature indicates that the species in the north temperate zone appear in the cool wet months of the spring and usually become less abundant during the warm months of summer. The Louisiana species described in this paper appear during the cool wet months of fall and disappear during the warm months of spring and summer.

After infection the host cell enlarges and the fungus grows and develops a thick wall which in some species is composed of three layers. When the fungus has attained its full growth it undergoes segmentation by the formation of membranes, which arise at the periphery, extend inward and finally form the sporangia. Zoospores are formed in the sporangia, escape and infect the young

<sup>1</sup> This genus was established by DeBary and Woronin. The name is a combination of the Greek *Syn* meaning *with* or *together* and *chytron* meaning a chamber. Ber. Nat. Ges. Freiberg 3: 22. 1863. Synonyms—*Chrysophlyctis* Schilbersky, Ber. Deut. Bot. Ges. 14: 36. 1896. *Pycnochytrium* (DeBary) Schroeter, Engler and Prantl, Nat. Pfl. I. 1: 73. 1897. *Woroninella* Raciborski. Zeitschr. Pflanz. 8: 195. 1898. *Miyabella* Ito & Homma. Mag. Tokyo Bot. Soc. 40: 110. 1926.



epidermal cells of other plants. In some species several generations are produced in a growing season. All species appear to have a dormant stage which carries them over until next growing season. All the species described in this paper appear to produce several generations during the cool, wet months of winter, but some appear to produce more generations than others. All these species disappear during the warm months of summer. The colors of the fungi and the surrounding host plant tissues are quite different. The color of the fungus is pale lemon when young but becomes yellow or orange with age. The color of the gall is due to the color in the host cells and not to the color of the fungus.

Tobler recognized 63 species of *Synchytrium* and reports a few others that are less well known. The literature indicates 90 or more and in all probability there are many that have not been described. Most species have been reported on a single host, but a few have been reported on two or more host species. They have been reported from the temperate and tropical zones, mostly from the north temperate zone. Many of these organisms are injurious to their host plants, especially to seedlings. Sometimes young plants are killed or are injured so severely that there is little later growth. The life histories of most species are not well known and in many cases descriptions are not satisfactory. All species described in this paper, with the possible exception of the one attacking *Lepidium*, cause dwarfing, and the one on *Geranium* causes very pronounced malformations.

Species reported on the same host but from different parts of the world are not necessarily identical, although they have been considered the same by some authors. Herbarium material is not satisfactory for writing descriptions or making comparisons. Some of the herbarium specimens have been found to contain rusts which have undoubtedly been mistaken for species of *Synchytrium*. Some of the early descriptions appear to be incorrect.

Most species cause enlargements of the infected and surrounding cells and cause the formation of tumors or galls. Kusano has reported that *S. fulgens* causes very slight enlargements of the cells of *Oenothera*. In Louisiana the species attacking *O. laciniata* and supposed to be *S. fulgens* causes pronounced enlargements



of the infected cells and thickenings of the leaves, due to an increase in the amount of mesophyll. It is possible that the Louisiana species on *O. laciniata* may be different from the one studied by Kusano on *O. biennis*. All other species studied by the writer cause very definite galls which are characteristic of the species and very important in writing descriptions and making determinations.

The descriptions in this paper are based on fresh material and the arrangement is based on the structure of the gall beginning with the simplest. The life histories of the fungi are so similar that the characters of the galls appear to be more reliable for determination of the species than the characters of the fungi. Even the measurements of the fungi are so variable as to be unsatisfactory for diagnosis, and the number of sporangia in a sorus is extremely variable. All species may cause simple or compound galls but compound galls are least common in *S. Hydrocotyles*. These compound galls may be due to crowding of infected cells or to the infection of the epidermal cells of a gall. The infection of a host cell by two or more zoospores is quite common, especially in *S. Chiltonii* on *Stellaria media*.

The descriptions of six new species and two which have been previously described are included in this paper.

#### SYNCHYTRIUM FULGENS Schroeter 1873.

Infections numerous on both surfaces of leaves and projecting slightly; on petioles and stems, simple or compound, not completely closed by growth of host cell; red, orange, or black; 88–116  $\mu$  in diameter; malformations are most pronounced over veins; no true galls as in most species but leaves become thickened; leaves become yellowish or reddish; thicker than normal and slightly roughened due to slight projections of epidermal cells, reddish and projecting, over sori; the thickenings are more pronounced on lower (*i.e.* in the mesophyll) than on upper surfaces; sori not completely covered by epidermal cells but appear to be sunken in the tissues of the host plant; sorus completely fills host cell,  $15 \times 24$  to  $42 \times 42 \mu$  in diameter; sporangia polyhedral, becoming spherical, walls thick and hyaline; 3–5  $\mu$  in diameter.

Habitat: *Oenothera laciniata* Hill,

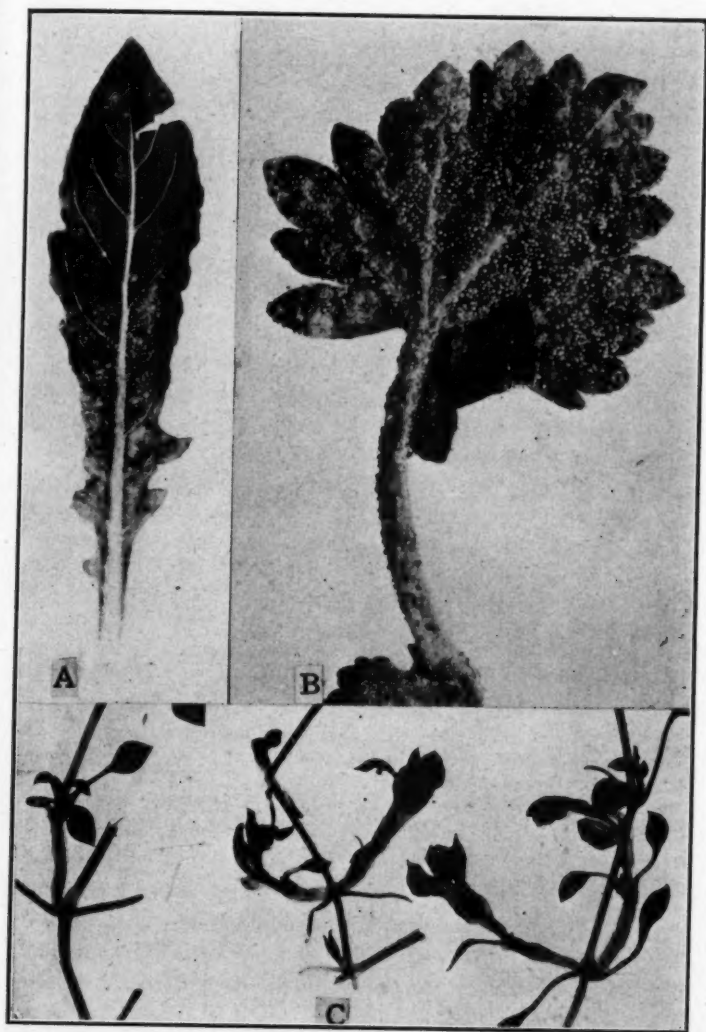


FIG. 1. A, *Synchytrium fulgens*, natural size; B, *S. modiolensis*,  $\times 5\frac{1}{2}$ ; C, *S. Chiltonii*,  $\times 1\frac{1}{2}$ .

**Synchytrium modioliensis** sp. nov.

Galls on both surfaces of leaves, petioles, stems, and ovaries (seed pods); usually simple, spherical, sori completely closed over by the host tissues; very little modification of the leaf structures; palisade cells slightly depressed; leaves yellow in early part of season, red to black late in season; sori orange, becoming black, the host cells clear or red. Galls maximum  $18 \times 24 \mu$ ; fungus yellow to orange,  $14 \times 18 \mu$ ; sporangia  $3\frac{1}{2} \times 7 \mu$ .

Gallis sphaericis, numerosis in utraque superficie foliorum, petiolis stirpibusque; egregie simplicibus; superficie plantae contagiis (punctis) contactus cum gallis minute (leviter) depressa; gallis flavis, dein in colorem aurantiacum, rubrum aut nigrum se mutantibus;  $18 \times 24$  diam.; soris aurantiacis,  $14 \times 18 \mu$ ; sporangiis  $3\frac{1}{2} \times 7 \mu$  diam.

Hab. *Modiola caroliniana* (L.) G. Don.

**Synchytrium Chiltonii** sp. nov.

Galls numerous, submerged in both surfaces of thickened leaves, enlarged petioles, enlarged stems, parts of flower and in buds; galls usually simple, flask-shaped but not closed; the basal part embedded in the tissues of the host; infected parts light green or yellowish; larger galls  $70 \times 83 \mu$  in diameter; plants dwarfed and stems swollen; sori  $48 \times 48 \mu$  in diameter; sporangia  $3\frac{1}{2} \mu$  or more in diameter.

Gallis numerosis in utraque superficie foliorum densatorum in petiolis amplificatis, in stirpibus auctis ampliatis et in partibus gemmarum florumque; egregie simplicibus ampulliformibus parte basali in hospitis textum submersa sed epidermide haud clausa;  $70 \times 83 \mu$  in diam.; plantis impeditis et partibus earum infectis tumidis; subviridibus aut subflavis; soris immersis,  $58 \times 58 \mu$  diam.; sporangiis  $3\frac{1}{2}$  vel plus diam.

Hab. *Stellaria media* (L.) Cyrill.

Spezzazini (1881) described *S. australe* on *Modiola prostrata* in Argentina but the description is quite different from the above.

Fuckel (1869) described *S. Stellariae* on *Stellaria media* and *S. nemorum* in Germany but the description is quite different from the above.

**Synchytrium Cerastii** sp. nov.

Galls mostly submerged in tissues on under surface of leaves, petioles, and stems; not numerous until late in season and not

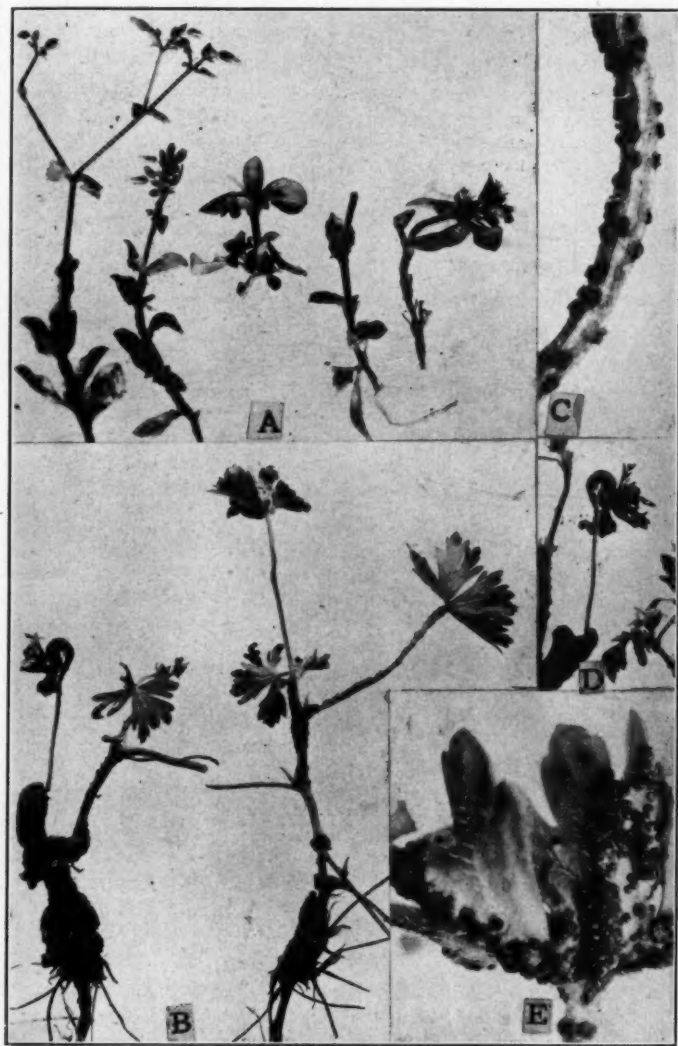


FIG. 2. A, *S. Cerastii*, slightly reduced; B-E, *S. Geranii*, B, slightly reduced; C,  $\times 5\frac{1}{2}$ ; D, slightly reduced; E,  $\times 5\frac{1}{2}$ .

found in flowers; flask-shaped; green and difficult to see in early part of season; pale yellow and finally black in late part of season; maximum  $56 \times 63 \mu$  in diameter; sori  $28 \times 28 \mu$  in diameter.

Gallis maximam partem sub foliorum superficiebus in petiolis stirpibusque; haud numerosis ad anni tempus paene peractum; pallide flavis in colorem nigrum tempore anni fere peracto se mutantibus ampulliformibus,  $56 \times 63 \mu$  diametro; soris immersis, epidermide haud clausis,  $28 \times 28 \mu$  diam.; sporangiis paucis  $3\frac{1}{2} \mu$  vel plus diametro.

Hab. *Cerastium viscosum* L.

The infections start later than those on *Stellaria media*, persist longer and are not so numerous but become quite abundant and conspicuous late in the season.

The flask-shaped inclosing cells are smaller than in *S. Chiltonii*, sporangia fewer, fungus more sensitive to stain.

#### SYNCHYTRIUM GERANII Clen.

Galls on all parts of the plant but rare in the bud and flower; very abundant on stems and leaves, most abundant on upper surface of leaves, red, simple or compound, not closed; lower half embedded in host tissue; sometimes the infections are so severe as to cause distortions of stems and leaves, stem sometimes much thicker than normal. Galls  $130 \times 130 \mu$  in diameter, rarely larger; sori  $73 \times 73 \mu$  in diameter; maximum size of sporangia  $7\frac{1}{2} \mu$  in diameter.

Hab. *Geranium carolinianum* L.

#### Synchytrium Edgertonii sp. nov.

Galls occur on either surface of leaves and on petioles; small, white, becoming brown with white border and finally entirely brown and brittle; simple or compound, closed, project on either or both surfaces of leaves, becomes black with age. When mature the host tissues break down, leaving a hole in the leaf. Galls  $63 \times 63$  to  $14 \times 140 \mu$  in diameter; sori submerged,  $82 \times 82 \mu$  in diameter; sporangia  $4-7 \mu$  in diameter.

Gallis in utraque superficie foliorum et petiolis, simplicibus aut compositis ex alterutra aut utraque superficie eminentibus, viridibus, in colorem nigrum aetate se mutantibus. Gallis maturis,  $63 \times 63$  ad  $140 \times 14 \mu$  diametro, textus hospitis se refrigit utque eo foramina in foliis relicta sunt soris immersis  $82 \times 82 \mu$  diametro; sporangiis  $4-7 \mu$  diametro.

Hab. *Dichondra repens* Forst.

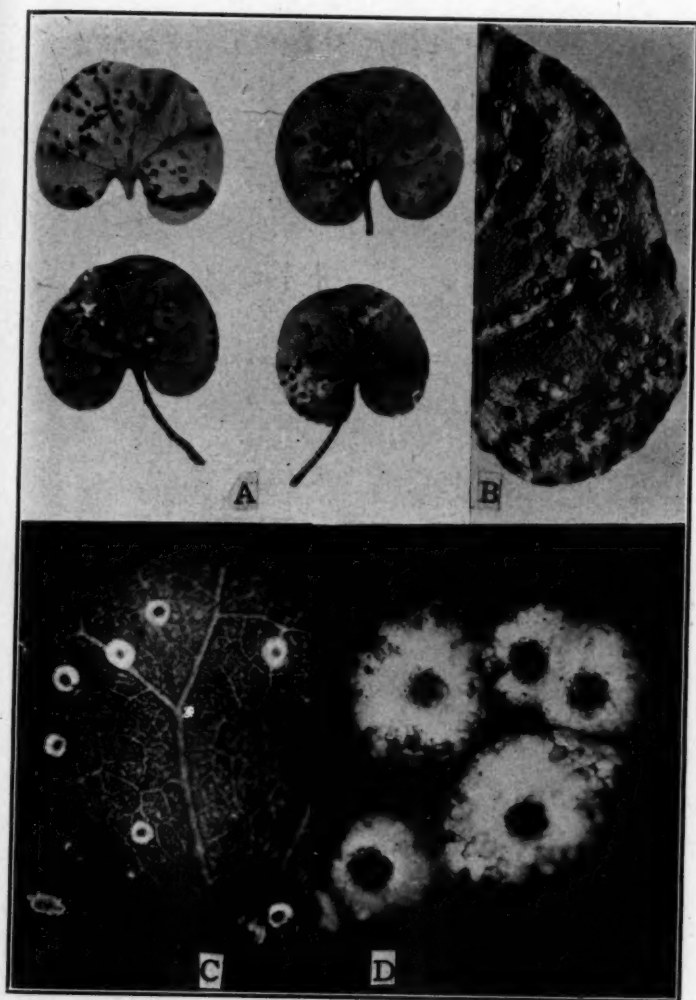


FIG. 3. A-D, *S. Edgertonii*, A,  $\times \frac{1}{2}$ ; B,  $\times \frac{1}{2}$  from dried specimen; C, enlarged; D, enlarged.

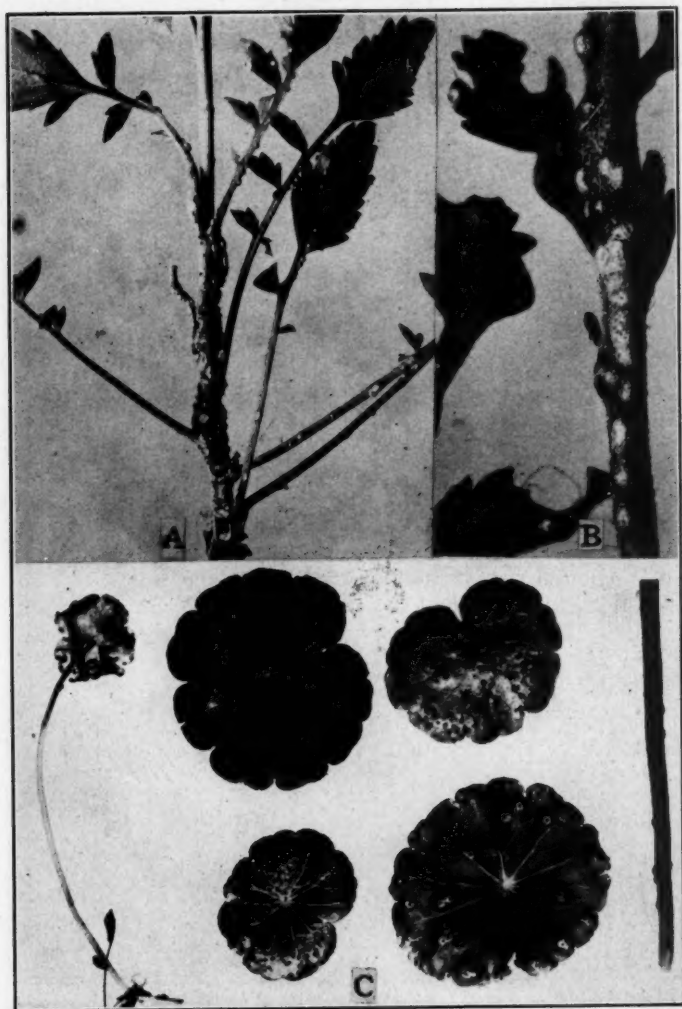


FIG. 4. A-B, *S. Lepidii*, A, natural size; B,  $\times 5\frac{1}{2}$ ; C, *S. Hydrocotyles*,  $\times \frac{1}{2}$ .



**Synchytrium Lepidii** sp. nov.

Galls on leaves (usually lower surface), petioles, and stems; very large, simple or compound, closed; sometimes projecting equally on both surfaces of leaves and sometimes resting on the surface of host plant. Early infections inconspicuous, green, becoming pale yellow and grayish or brown with age. Galls  $130 \times 130$  to  $175 \times 175 \mu$  in diameter; sori  $40 \times 40$  to  $52 \times 52 \mu$  in diameter; sporangia about  $4 \mu$  in diameter.

Gallis in foliis, petiolis stirpibusque, in alterutra superficie foliorum aut ex alterutra aut utraque eminentibus; simplicibus vel compositi; manifestis viridibus, pallide flavis subgriseis in colorem brunneum aetate se mutantibus,  $130 \times 150$  ad  $175 \times 175 \mu$  diametro; soris  $40 \times 50$  ad  $52 \times 53 \mu$  diametro; sporangiis  $4 \mu$  diam.

Hab. *Lepidium virginicum* L.

**Synchytrium Hydrocotyles** sp. nov.

Galls mostly on the under surface, usually causing a pit on the under surface and a dome on the upper but the reverse may occur; black spot at bottom of pit indicates point of infection. Sometimes a papilla is formed at the bottom of the pit. Sometimes a papilla is formed on the margins of leaves without the pit. The dome may become pale yellow; the papilla may be darkened and the entire gall may become black, especially in the margins of the leaves. Fungus orange. Galls closed, maximum size  $175 \times 280 \mu$  in diameter; sorus lemon yellow, becoming orange,  $42 \times 42 \mu$  in diameter. Some on either side; black spot at bottom of dome indicates point of infection. Fungus lemon yellow becoming orange.

Gallis in foliis petiolisque; tholoideo cum papillis nigris in latere concavo puncto contagionis (contagi); tholo pallide lurido flavo; papillis rubidis vel nigris in marginibus praecipue foliorum; gallis  $140 \times 175$  ad  $175 \times 280 \mu$  diametro; soris limono-flavis vel aurantiacis,  $42 \times 42 \mu$  diam.

Hab. *Hydrocotyle umbellata* L. et *H. Canbyi* Coult. and Rose.

Spegazzini (1881) described *S. bonaerense* on *Hydrocotyle bonaerensis* in Argentina but the description differs from the above.

The writer wishes to thank Dr. C. W. Edgerton, Dr. Clair A. Brown, Dr. L. H. Flint, Dr. S. J. P. Chilton, and others who have assisted the writer in making these studies.

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## SOME NOTEWORTHY RUSTS—I

M. J. THIRUMALACHAR

(WITH 21 FIGURES)

In the course of studies on the rust flora of Mysore State (South India) large collections of a rust on the leaves of *Ichnocarpus frutescens* Br. were secured from various localities. The rust had for the most part only uredial stages and completely agreed with the descriptions of *Uredo Ichnocarpi* Barclay. This was further confirmed by comparative studies with a specimen obtained from the Herb. Crypt. Ind. Orient, New Delhi. The uredia, which can be collected almost all the year round, are subepidermal (FIG. 1), occurring in large numbers and completely covering the underside of the leaf. Many of the sori are also epiphyllous. The infection spots can be made out as pale yellow specks on the dark green surface of the leaves. The urediospores are golden yellow, developing singly on pedicels (FIG. 1). The ruptured epidermis is very conspicuous and the sori are aparaphysate. The exospore is minutely and densely verruculose. The germ pores are indistinct and become visible only at the time of germination.

The urediospores readily germinate when placed on slides in a moist chamber. The tip of the germ tube becomes swollen developing an appressorium. Inoculation experiments revealed that the urediospores readily infect the same host, causing the formation of secondary uredia. A close watch was kept on all the infected plants to observe any telial stages for the rust, if present, which might enable one to establish the identity of the rust. It was, however, noticed that the rust could perenniate in most cases in the uredial stage itself, as in the cases of some tropical rusts. But the formation of telia was noticed developing both within the uredia as well as separately. This afforded an opportunity to study the rust in some detail.

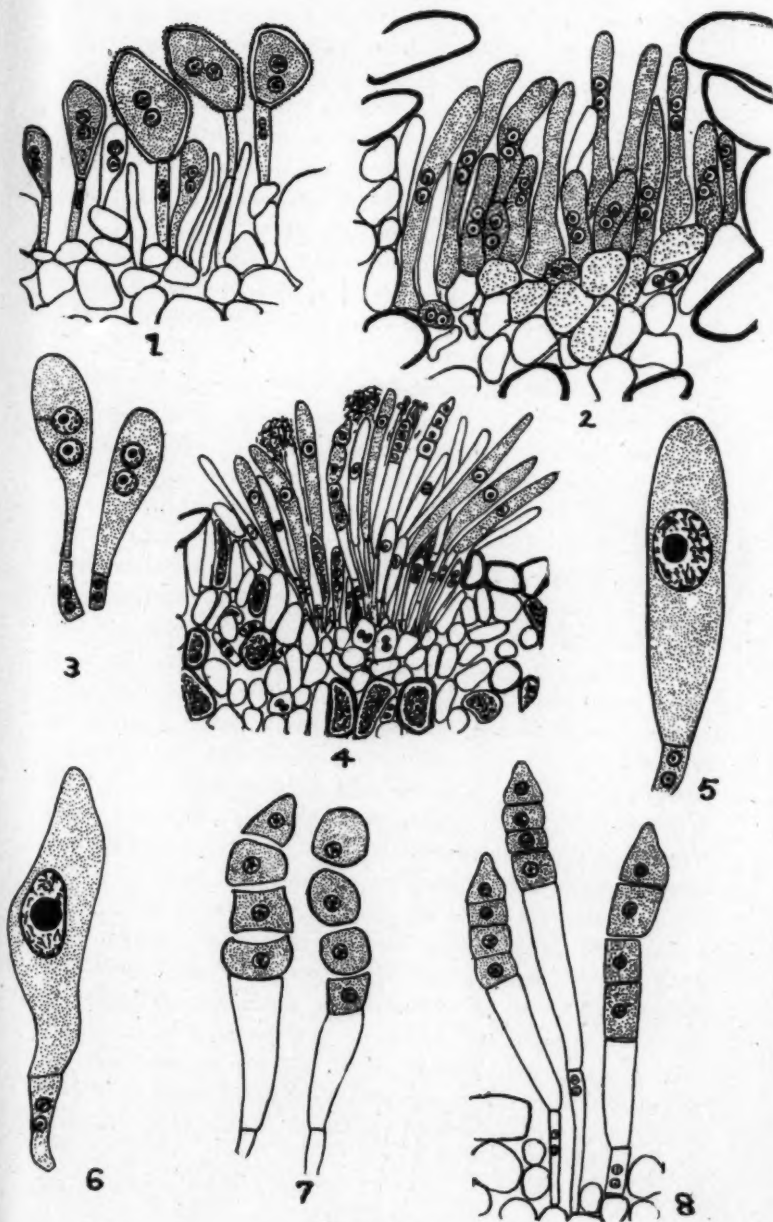
The material for microscopic studies was fixed in Allen's modification of Bouin's fluid and stained with Heidenhain's iron-alum

haematoxylin, with eosin-B in clove oil as counterstain. The development of the spore forms and all the morphological details were studied in microtome sections. The urediospores are golden yellow, developing singly on pedicels and agreeing in all respects with *Uredo Ichnocarpi* Barclay. Sydow and Petrak (1928), who founded the genus *Achrotelium* on *Ichnocarpus Volubilis* from the Philippines, state that *Uredo Ichnocarpi* found in India might also belong to the same rust genus *Achrotelium*.

The telial stages of the rust which have been recorded in the present study clearly indicated that the rust is not cogenetic with *Achrotelium*. The telia appear as fluffy pustules and easily can be mistaken for old uredia. The teliospores have been found developing within the uredia, thus indicating the genetic relationship between the two spore forms. The telial initials are sub-epidermal in origin (FIG. 2). Small hyphoid cylindric cells borne on short pedicels mark out young telia (FIG. 3). As development proceeds, the sorus becomes organized, consisting of long clavate, hyaline teliospores borne on short pedicels. The shape of the sori, unlike as in other rusts, is like an acervulus (FIGS. 4 and 20). In the young teliospores the binucleate condition is conspicuous (FIG. 3) and a fusion nucleus is formed in the mature spores (FIGS. 5 and 6). The nuclei of the pedicels are also conspicuous surrounded by densely staining cytoplasm.

The teliospores germinate intrasorum soon after maturity (FIG. 7). Prior to germination the fusion nucleus in the teliospore slightly migrates upwards accompanied by the prolongation of the spore apex. The prolongation of the spore apex does not take place to appreciable extent so as to form a recurved promycelium as in rusts like *Maravalia* or *Scopella*. The distinction between the promycelium and the teliospore is lost soon after germination as they become uniformly broad throughout the length. The germinated spores can be differentiated from the non-germinated spores by being longer and narrower. The first wall is laid right

FIG. 1, uredium of *Acerulopsora Ichnocarpi*,  $\times 640$ ; 2, young telium,  $\times 640$ ; 3, young teliospore,  $\times 800$ ; 4, mature telium showing the acervulus-like sori,  $\times 400$ ; 5 and 6, mature teliospores,  $\times 800$ ; 7 and 8, germination stages showing the rounding off of the promycelial cells as basidiospores,  $\times 800$ .



FIGS. 1-8.

in the center with the result that the promycelium thus separated includes the apical portion of the teliospore, and must be considered as being semi-internal.

Following the usual mode of development the promycelium becomes four-celled, each cell showing a conspicuous nucleus (FIGS. 8 and 21). The cells are very fragile and even in the early stages of development show a tendency to get separated. In later stages these cells get separated as round cells (FIGS. 7 and 21) which might directly function as basidiospores or develop secondary basidiospores, a feature not confirmed in the present investigation. The development of sterigmata with basidiospores at their tips has not so far been observed.

Following teliospore germination and the consequent rounding off of the cells of the promycelium into basidiospores, the pedicel also shows some amount of elongation. The germinated spores are pushed farther upwards than the rest of the ungerminated spores within the sorus. The pedicels which in the mature spores measure up to  $13.5\ \mu$  elongate up to  $48\ \mu$  in the course of the teliospore germination. After the dispersal of the basidiospores the portion of the teliospore beneath the promycelium collapses and gelatinizes. The pedicels remain persistent for a long time and can be observed as fusiform structures.

The structure and germination of the teliospore presents an interesting problem in the identity of the rust. That it is not *Achrotelium* is evident by the differences in the structure and germination of the teliospores. In *Achrotelium Inchnocarpi* Syd. Arthur and Cummins (1936) have shown that the teliospores arise in clusters on sporogenous basal cells and that the promycelium is internal, developing basidiospores on short sterigmata. This feature has been confirmed by Cummins (1940) in *A. Lucumae* Cum. The teliospores of the rust under study on the other hand develop singly on pedicels and not in clusters and the basidium is semi-internal since there is a definite prolongation of the spore apex in the process of germination. In the genera *Chrysella* Syd. and *Goplana* Racib., the internal basidium is a distinguishing character, and particularly in the latter genus there is a gelatinous matrix embedding the teliospores.

The genera like *Maravalia* Arth., *Scopella* Mains and others can be distinguished from the present rust by the nature of the promycelium which is external and distinct from the teliospore. A wall separating the apex of the teliospore from the promycelium is considered to be an important character of the genus *Blastospora* Diet. Indeed, in the present rust the first wall is laid down lower still, following germination, including the apical half of the teliospore to the extent of its being semi-internal. Further, the super-stomal telia present in *Blastospora* separates the two genera. Semi-internal promycelium is at present known only in two genera of rusts, viz. *Cystospora* Butler and *Zaghouania* Pat. which, however, possess other distinguishing characters.

In the possession of an acervulus-like telium and a fragile four-celled promycelium, the present rust shows a good deal of resemblance to *Chrysocelis* Lagerh. In *Chrysocelis Muehlenbeckiae* Lagerh. & Diet., for instance, Dietel (1914) reports that the telia are acervular, the basidiospores being formed by the rounding up of the cells of the promycelium (Dietel, 1928). This situation reminds us of the condition present in the rust under study, but the semi-internal promycelia and stipitate teliospores are distinguishing features. The tendency of the pedicel to elongate following germination is also noticed in the case of *Chrysocelis ascotela* (Syd.) Thirumalachar (1942). While in these above mentioned characters there is a close resemblance between *Chrysocelis* and the present rust, the type of germination is a distinguishing character. For instance the genus *Chardonella* is separated from *Chrysospora* only by the internal basidium present in the latter. It is not always possible to seek evidences of spore germinations in identifying the rust genera, but when such evidences become available, they must be taken into account as they are critical stages in the life-cycle of the rusts. It is manifest that the present rust cannot be accommodated in any of the genera of rusts so far described and hence it is placed in a separate genus for which the following name is proposed.

***Acervulopsora* gen. nov.**

*Pycnia* atque *aecia* ignota. *Uredia* subepidermalia; *urediosporae* singulis *pediculis* isidentes. *Telia* subepidermalia, erumpentia, *acervulo* similia, *telio-*



spora clavatae, hyalinae tenuibus parietibus ornatae, singulis pediculis insidentes, maturae spora germinantes in soro, producto sporarum apice; promycelium semi-internum (inclusa superiore parte teliosporae), 4-cellulatum; sporidia formantur rotundatis promycelii cellulis.

Species typica: *Acervulopsora Ichnocarpi* (Barclay) Thirumalachar.

Pycnia and aecia unknown. Uredia subepidermal, urediospores borne singly on pedicels. Telia subepidermal erumpent, acervulus-like; teliospores clavate, hyaline, thin-walled, borne singly on pedicels; germinating intrasorum at maturity by the prolongation of the spore apex; promycelium semi-internal (including the upper portion of the teliospore), four-celled; sporidia formed by the rounding off of the promycelial cells.

Type species, *Acervulopsora Ichnocarpi* (Barclay) Thirumalachar.

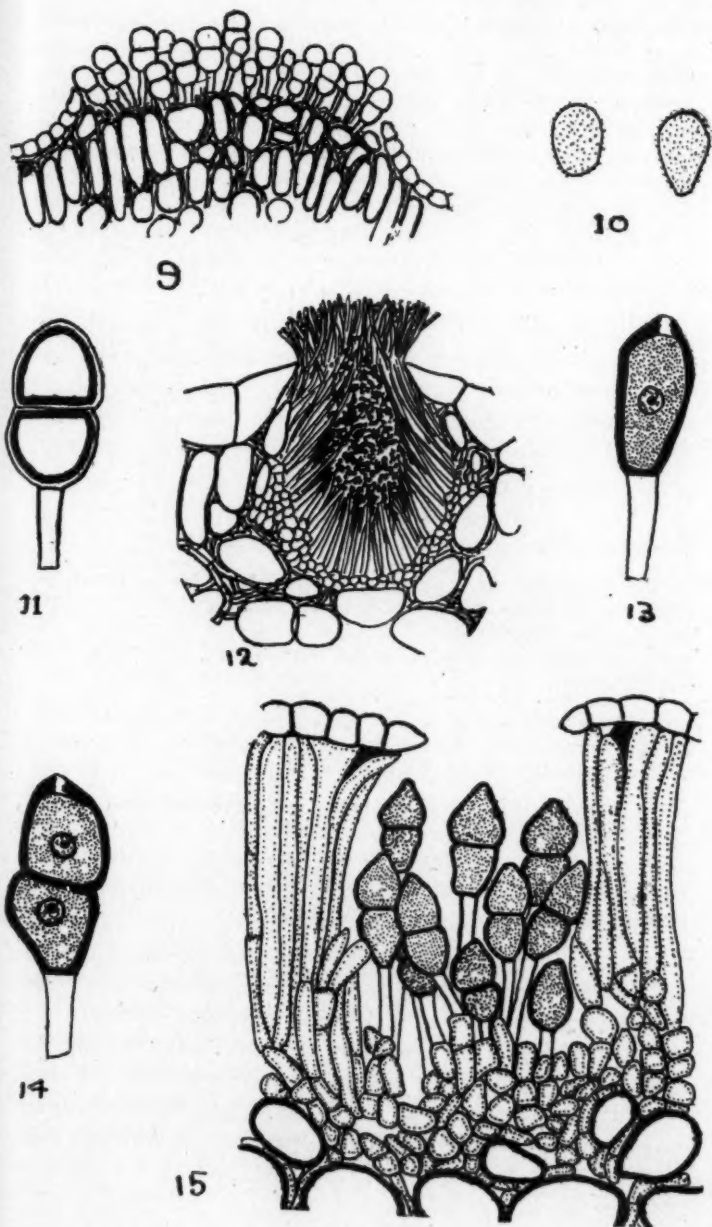
**Acervulopsora Ichnocarpi** (Barclay) Thirumalachar, comb. nov.

Uredia ut plurimum hypophylla, raro amphigena, subepidermalia, erumpentia atque aparaphysata; infectionis maculis pallide lutea, sorus flavidus; urediosporae obovatae vel ellipsoideae, minutae atque dense verruculosae, magnitudinis  $19-25 \times 15-20 \mu$  germinationis poro indistincto, singulis pediculis insidentes. Telia primo in urediis, evolventia, deinde separate evoluta, albida atque languinosa, subepidermalia, acervulo similia, erumpentia; teliosporae clavatae, in utrinque apice rotundatae, magnitudinis  $30-41 \times 7-8.5 \mu$ ; pedicellatae; maturae spora germinantes in soro, producto sporarum apice; promycelium semi-internum, primo pariete efformato in media teliosporarum parte; 4-cellulatum, sporidia producta rotundatis promycelii cellulis, fragilia, facile disjuncta, magnit.  $5-8.5 \times 7-8 \mu$ . Pediculi hyalini, persistentes, crescentes ad  $48 \mu$  impellentes teliosporas germinantes supra ingerminatarum sporarum planum.

Habitat in foliis *Ichnocarpi frutescentes*, Yashavantapus (Mysore), 14-8-1942, leg. M. J. Thirumalachar (typus). Typus positus in auctoris herbario; in Herb. Crypt. Ind. Orient in Imp. Agric. Res. Inst. New Delhi; in Arthur Herbario, Purdue Univers. Lafayette, Indiana, U. S. A., in Herb. Imp. Mycolog. Inst. Kew. in Anglia.

Uredia mostly hypophyllous, rarely amphigenous, subepidermal, erumpent and aparaphysate; infection spot pale yellow, sorus golden yellow, urediospores obovate to ellipsoid, minutely and densely verruculose, measuring  $19-25 \times 15-20 \mu$  with indistinct

FIG. 9, telium of *Puccinia Volutarellae*,  $\times 400$ ; 10, urediospores of *Puccinia bellurensis*,  $\times 450$ ; 11, teliospores of *P. bellurensis*,  $\times 450$ ; 12, pycnium of *P. boerhaviaefoliae*,  $\times 400$ ; 13, mesospore,  $\times 800$ ; 14, teliospore,  $\times 800$ ; 15, mature telium showing the elongated plectenchyma cells,  $\times 400$ .



FIGS. 9-15.

germ pores and borne singly on pedicels. Telia primarily developing within the uredia, later formed separately, white and fluffy, subepidermal, acervulus-like, erumpent, teliospores clavate, rounded at both ends, measuring  $30-41 \times 7-8.5 \mu$  pedicellate, germinating intrasorum by prolongation of spore apex, promycelium semi-internal, first wall being laid within the middle of the teliospore region, four-celled, sporidia formed by rounding up of the cells of the promycelium, fragile, easily separating and measuring  $5-8.5 \times 7-8 \mu$ . Pedicels hyaline, persistent, elongating up to  $48 \mu$ , pushing the germinating teliospores above the level of the non-germinated spores.

Hab. On leaves of *Ichnocarpus frutescens* Br., Yashavantapur (Mysore), 14-8-1942, leg. M. J. Thirumalachar (Type). Type deposited in the author's herbarium, Herb. Crypt. Ind. Orient. of the Imperial Agric. Res. Inst. New Delhi; Arthur Herbarium, Purdue University, Lafayette, Indiana, U. S. A. and in the herb. of the Imperial Mycological Institute, Kew, England.

***Puccinia Volutarellae* Thirumalachar, sp. nov.**

Telia hypophylla, raro amphigena, subepidermalia, minuta, sparse distributa, paraphysata atque nigra, soris tenuiter pulvinatis; teliosporae ovatae vel ellipsoidae, brunneo-luteae, rotundatae, in utroque apice, tenuiter constrictae in septis, minute atque delicate verruculosae, magnitudinis  $28-44 \times 17-24 \mu$ .

Habitat in foliis viventibus *Volutarellae divaricatae* Benth. 28-12-1942, in loco Bellur, in regione Mysore; leg. M. J. Thirumalachar. Typus positus in Herb. Crypt. Ind. Orient, New Delhi.

Telia hypophyllous, rarely amphigenous, subepidermal, minute, sparsely distributed, paraphysate and black, sori slightly pulvinate; teliospores ovate to ellipsoid, yellowish-brown, rounded at both ends, slightly constricted at the septa, minutely and finely verruculose, measuring  $28-44 \times 17-24 \mu$ .

Hab. On living leaves of *Volutarella divaricata* Benth., 28-12-1942, Bellur, Mysore State, leg. M. J. Thirumalachar. Type deposited in the Herb. Crypt. Ind. Orient New Delhi (FIG. 9).

Only telia of this rust have so far been observed. The infection spots are not visible on the upper surface, the sori which are black being as a rule hypophyllous. There are no paraphyses within the sori which are somewhat pulvinate. It differs from the other rusts

so far recorded on the Compositae. Mature teliospores germinate after a period of rest when placed in moist chambers. The promycelium is four-celled, bearing globular sporidia.

***Puccinia bellurensis* Thirumalachar, sp. nov.**

Uredia amphigena, per folia atque culmos dispersa, minuta, pulverulenta atque aparaphysata; urediosporae oblongo-ellipsoidae, subglobosae, pallide luteae, tenuiter brunneae tinctae, episporio minute atque delicate papillato, duobus germinationis poris instructae, magnitudinis  $18-24 \times 17-20.5 \mu$ . Telia saepissime caulina, orta post amotas urediosporas quarum locum occupant, teliosporae 2-cellulae, castaneo-brunneae, leves, tenuiter constrictae in septis obtusae in utroque apice, sporarum apice crasso, magnitudinis  $33-43 \times 17-23 \mu$ . Pediculis hyalinus, persistens, ad  $36 \mu$ . longus.

Habitat in foliis *Evolvuli alsinoidis* L. in loco Bellur (Mysore), 28-12-1942, leg. M. J. Thirumalachar. Typus positus in Herb. Crypt. Ind. Orient, New Delhi.

Uredia amphigenous, distributed on leaves and stems, minute, pulverulent, and aparaphysate; urediospores oblong-ellipsoid, subglobose, pale yellow with brownish tinge; episporio minutely and finely papillate with two germ pores and measuring  $18-24 \times 17-20.5 \mu$ . Telia mostly cauline, developed by replacing the urediospores; teliospores two-celled, chestnut-brown, smooth, slightly constricted at the septa, pointed at both ends, spores slightly thickened at the apex, measuring  $33-43 \times 17-23 \mu$ . Pedicel hyaline, persistent, up to  $36 \mu$  long (FIGS. 10 and 11).

Hab. On leaves of *Evolvulus alsinoides* L., Bellur, 28-12-1942, leg. M. J. Thirumalachar. Type deposited in the Herb. Crypt. Ind. Orient, New Delhi.

*P. bellurensis* does not bear any resemblance to *Puccinia tuyutensis* Speg. recorded on *Evolvulus falcata* and *E. glabra* in South America, because it has deep yellowish brown and smooth urediospores as against pale yellowish brown and minutely papillate urediospores of the present rust. Furthermore the teliospores of *P. tuyutensis* are broader ( $22-28 \mu$ ) than those of *Puccinia bellurensis* which are  $17-23 \mu$ . As specimens of *Uredo Evolvuli* Speg., which is also reported from South America, are not available for comparison and since its telial stage is unknown, its status will have to remain uncertain for the present.

***Puccinia boerhaviaefoliae* Thirumalachar, sp. nov.**

*Pycnia* amphigena, subepidermalia, citro-lutea. *Aecia* amphigena, dense aggregata, in infectionis maculis, cupulata, erumpentia, peridio bene evoluto; aeciosporae luteae, polyhydrates, minute verruculosae, magnitudinis,  $15-21 \times 10-17 \mu$ . Peridii cellulae amplae, hyalinae, angulariter globoidae, dense rugosae. Telia ut plurimum in culmis, initio citro-lutea, tum nigra, atque erumpentia, in distinctis loculi efformatis elongato plectenchymate vallo simili; teliosporae pedicellatae, tenuiter constrictae in septis, castaneo-brunneae, rotundatae vel attenuatae in apice, leves, magnitudinis  $34-46 \times 12-19 \mu$ . Pediculo persistente, luteobrunneo, ad  $20-36 \mu$  longo; mesosporis associatis, magnitudinis  $19-36 \times 8.5-19 \mu$ .

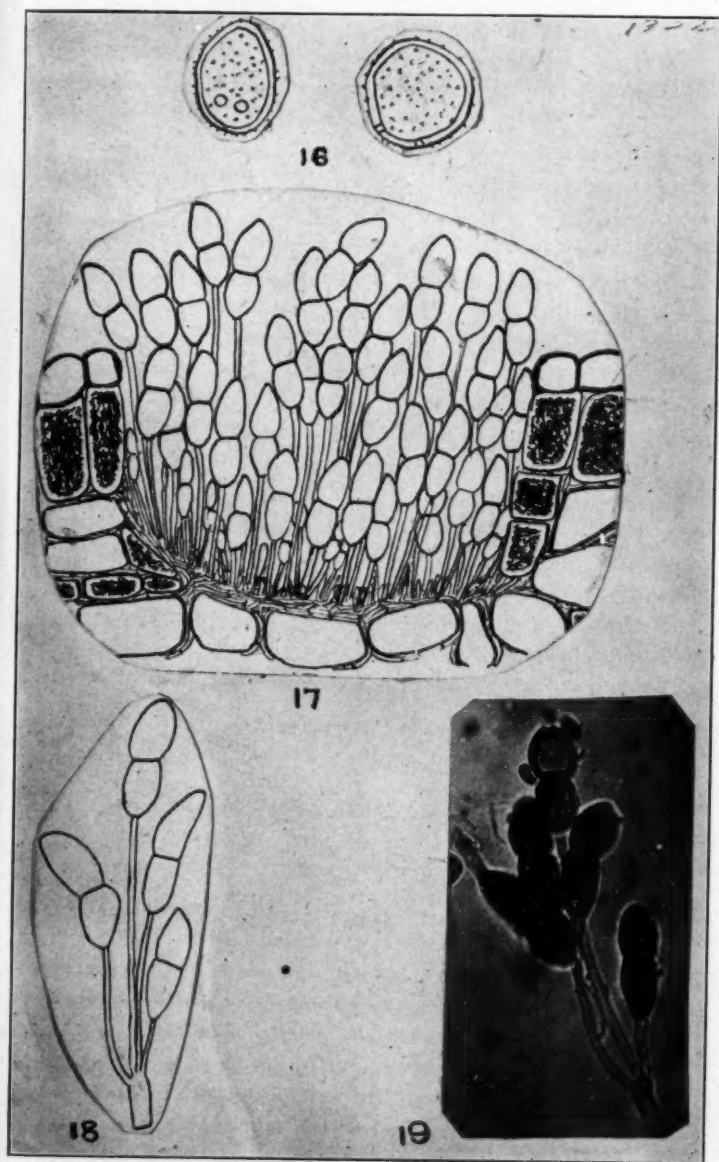
Hab. in foliis atque virgultis *Blepharidis boerhaviaefoliae* Pers. in loco Yashavantapur, 14-8-1942, legit M. J. Thirumalachar. Type deposited in the Herb. Crypt. Ind. Orient, New Delhi.

*Pycnia* amphigenous, subepidermal, orange-yellow. *Aecia* amphigenous, densely aggregated on the infection spot, cupulate, erumpent, with well developed peridia; aeciospores yellow, polyhedral, minutely verruculose, measuring  $15-21 \times 10-17 \mu$ . Peridial cells large, hyaline, angularly globoid, densely rugose, measuring  $21-29 \times 14-25 \mu$ . Telia mostly on the stem, orange-yellow in early stages, later black and erumpent, in distinct locules formed by the elongated palisade-like plectenchyma; teliospores pedicellate, slightly constricted at the septa, chestnut-brown, rounded or attenuated at the apex, smooth, measuring  $34-46 \times 12-19 \mu$ . Pedicel persistent, yellowish brown, up to  $20-36 \mu$  long, mesospores associated, measuring  $19-36 \times 8.5-19 \mu$ .

Hab. On leaves and twigs of *Blepharis boerhaviaefolia* Pers., Yashavantapur, 14-8-1942, leg. M. J. Thirumalachar (FIGS. 12-15).

Comparative studies of the aecia of *Puccinia boerhaviaefolia* and *Aecidium Blepharidis* Har. & Pat. (collected by McRae near Coimbatore and identified by Sydow (1914) obtained from the Herb. Crypt. Ind. Orient, New Delhi, indicated that the two rusts are identical. Average of 100 spore measurements for the two rusts is as follows:  $17.3 \times 14.5 \mu$  for the aeciospores of *P. boerhaviaefoliae*, and  $17.3 \times 14 \mu$  for the rust collected by McRae. *Puccinia Blepharidis* P. Henn., which was recorded by Hennings

FIG. 16, urediospores of *Puccinia Solmsii*,  $\times 800$ ; 17, mature telium,  $\times 560$ ; 18, showing the teliospore cluster on sporogenous basal cell,  $\times 640$ ; 19, photomicrograph of the same,  $\times 600$ .



FIGS. 16-19.



from Africa, has also been described by Doidge (1926). Recently another rust on the same host species, *Blepharis boerhaviaefolia*, has been described by Cummins (1941) under the name *Puccinia makenensis* Cum. The latter rust somewhat resembles *P. Blepharidis*, but differs in possessing loculate paraphysate telia. In the rust under study also there is such a loculate telium, and comparison with the photomicrographs given by Dr. Cummins indicates that they doubtlessly develop in the same manner. However, a close morphological study of the development of the sori by the writer revealed that the tissue separating the locules should not be considered to be of the nature of paraphyses. The young telial initial is formed by the concentration of hyphae beneath the epidermis to form a plectenchyma. Soon, an elongated vertical row of cells are arranged in a palisade-like manner. Teliospores that are formed from the base of the hymenium push apart these palisade-like hyphal cells and in the mature telium a loculate appearance for the sorus is presented. It is possible that even in *P. makenensis* the hyphal tissue separating the locular telium might be of the same nature.

Loculate telia no doubt distinguish *P. makenensis* and *P. boerhaviaefoliae* from *P. Blepharidis*. When the spore measurements of these three rusts are taken into account, the following facts become apparent:

	Aeciospores	Peridial cells	Teliospores
<i>P. Blepharidis</i> (E. M. Doidge)	15-22 × 12-19 μ	16-20 × 10-16 μ	35-58 × 18-28 μ
<i>P. boerhaviaefoliae</i>			
<i>P. makenensis</i> (Cummins)	13-17 × 17-20 μ	14-20 × 16-26 μ	48-66 × 17-27 μ

The measurements, while indicating close relationships between the three rusts as regards aeciospore measurements, show differences in the sizes of the teliospores and peridial cells. *Puccinia boerhaviaefoliae* has smaller teliospores as compared with the other two rusts. Further, the smaller peridial cells in *Puccinia makenensis* clearly distinguishes it from *P. boerhaviaefoliae*.



*PUCCINIA SOLMSII* P. Henn.

The rust on *Polygonum chinense* was first described by Hennings under the name *Puccinia Solmsii* P. Henn., having uredial and telial stages. Raciborski (1900) while recording the species from Java described an aecial stage for the rust without making any mention of the uredial stages described by Hennings. The Sydows (1904), while referring to *P. Solmsii*, state that Hennings might have mistaken the pedicels of the teliospores for urediospores. However, a detailed study of the same rust collected by the writer in Nandi Hills (Mysore State) revealed the presence of both uredial and telial stages of the rust and other interesting features which are presented here.

Only uredial and telial stages of the rust have been observed. The uredia are minute, hypophyllous, developed on small pinkish infection spots. The urediospores are oblong-elliptic, cinnamon-brown, minutely and finely verruculose, with two distinct germ pores (FIG. 16). Telia are developed (FIG. 17) on slightly raised pulvinate infection patches, amphigenous and subepidermal. The teliospores arise in clusters on proliferating basal cells which are laterally free. There are six to eight spores in a cluster (FIGS. 18 and 19) and these can be made out only in carefully teased preparations. Mature teliospores are two-celled, thin-walled, pale yellowish brown, with a distinct germ pore in each cell. The spores germinate readily within the sorus without a period of rest being necessary.

The occurrence of clustered teliospores on laterally free sporogenous basal cells is a very distinguishing character of rust genera like *Chaconia* Juel, *Scopella* Mains and others. In fact in the possession of two-celled teliospores on sporogenous basal cells, the present rust can be compared with *Coniostelium* Syd. and *Prospodium* Arth. But unlike these two genera, the urediospores are borne singly on pedicels and not in clusters. Further, the sporogenous basal cells are so fragile that the clustered nature could be made out only in carefully prepared sections. For the present, the rust is retained under *Puccinia* as *P. Solmsii* P. Henn.

## UROMYCES MUCUNAE Rabenh.

*Uromyces Mucunae* Rabenh. was first described by Rabenhorst as being parasitic on the leaves of *Mucuna puriens* DC., on the basis of the material collected by Kurz in the Botanical Gardens, Calcutta (India). It is now known to occur on other species of *Mucuna* including *M. utilis* or the velvet beans (Doidge, 1926). Only uredia and telia are so far known for the rust.

Since the rust occurs in profusion round about Bangalore, opportunity was taken to study the morphology of the spore forms including its life-cycle. Uredia are hypophyllous, scattered over the entire surface of the leaves, the urediospores being hyaline with densely echinulate exospore and possessing four scattered germ pores. The telia which replace the uredia are brownish black. The teliospores are chestnut-brown with a blackish tinge, globose, with an apical indistinct germ pore. The exospore shows a large number of warts which are arranged in longitudinal rows, making the spores appear somewhat striate. The teliospores germinate only after a period of rest.

Mature teliospores which were collected and stored in the laboratory readily germinated after a three months rest period, when placed in moist chambers. The promycelium becomes recurved, bearing four globular basidiospores. Germinating teliospores were placed on young leaves of *Mucuna puriens*, the inoculated plants being inclosed in moist chambers for 24 hours. Development of pycnia in the inoculated area after ten days as greenish yellow specks indicated the autoecious nature of the rust. Pycnia are emphygenous, subepidermal, flask shaped with well developed ostiolar hyphae. Uredia follows pycnia in development. The urediospores readily germinate and bring about secondary infection.

In conclusion the writer wishes to acknowledge his indebtedness to Dr. B. B. Mundkur, Imperial Agricultural Research Institute, New Delhi, for guidance and valuable suggestions given in the course of this work. Grateful thanks are due to Dr. L. N. Rao, Professor of Botany, University of Mysore, for kind encouragement and to Rev. Father H. Santapau, Ph.D., S.J., St. Xavier's

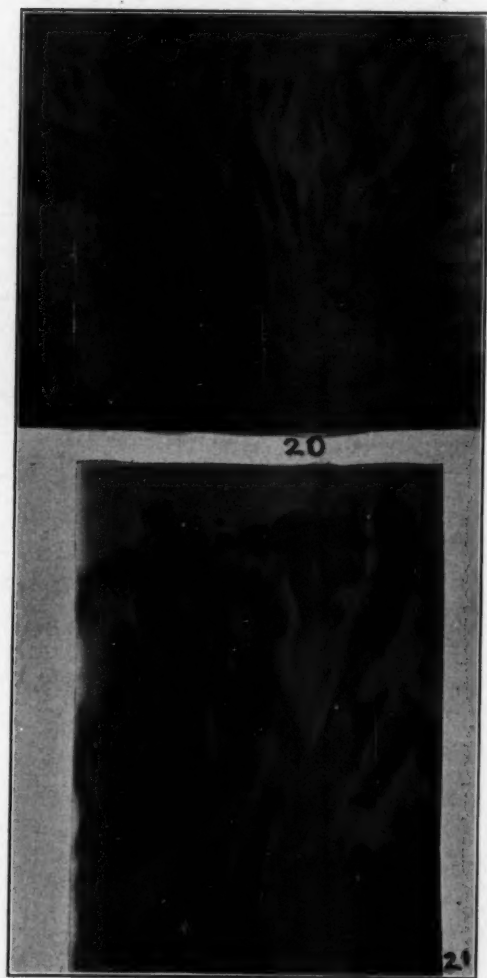


FIG. 20, photomicrograph of the telium of *Acervulopsora Ichnocarpi*,  $\times 450$ ; 21, photomicrograph of the germinating teliospores showing the fragile promycelium in the extreme right spore and rounding off of the spores in the others,  $\times 800$ .

College, Bombay, for kindly writing the Latin diagnosis of the new genus and species.

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## SOME NEW SPECIES OF FUNGI ON LIBOCEDRUS

EDITH K. CASH

(WITH 5 FIGURES)

Among collections of Discomycetes from California referred to the writer at various times during recent years have been several specimens of fungi growing on *Libocedrus decurrens* Torr. which are apparently distinct from any of the species described in the available literature and are therefore described here as new. One discomycete and an associated Sphaeropsidaceous fungus on branchlets have been collected by H. E. Parks along the Middle Fork of the Smith River, Del Norte County, several times from 1936 to 1945. Another discomycete on bark of *Libocedrus* has been found at various localities in the state by L. Bonar, C. R. Quick, E. P. Meinecke, and C. L. Shear.

Specimens of these fungi are deposited in the Mycological Collections of the United States Bureau of Plant Industry, Beltsville, Maryland, and in the Herbarium of the University of California, Berkeley, California.

### 1. *Parksia* gen. nov.

Apothecia superficialia, carnosio-coriacea, depresso-globosa, in lobis pluribus scindentia, dein plana vel convexa margine stellato; asci cylindrico-clavati, octospori; ascosporae hyalinae, unicellulares; paraphyses filamentosae, flexuosae; hypothecium crassum, subhyalinum plectenchymaticum; cortex fuscus, pseudoparenchymaticus.

Apothecia superficial, fleshy-leathery, depressed-globose, opening by splitting into lobes, then plane or convex with stellate margin; asci cylindrical-clavate, 8-spored; spores hyaline, ellipsoid, one-celled; paraphyses filamentous, flexuous; hypothecium thick, subhyaline, plectenchymatous; cortex dark, pseudoparenchymatous.

The genus is named for Mr. Harold E. Parks, to whose keen interest in the fungus flora of California the writer has been indebted for many valuable collections.

**Parksia Libocedri** sp. nov. (FIG. 1 and 4)

Apothecia substipitata, superficialia, 0.5-1 mm. diam., depresso-globosa, dein in lobis pluribus scindentia et plana vel convexa margine lobato, carnosocoriacea, fusco-brunnea usque cinnamomeo-brunnea; hymenium olivaceo-citrinum; asci cylindrico-clavati, octospori,  $90-110 \times 8-11 \mu$ ; ascospores 1-2-seriatae, ellipsoideo-ovoideae, unicellulares, hyalinae vel subhyalinae,  $9-11 \times 3-5 \mu$ ; paraphyses hyalinae, tenues, filamentosae, ramosae, apice inflatae et viridescentes; hypothecium subhyalinum, plectenchymaticum; cortex pseudoparenchymaticus, cellulis fuscis angularibus crasse tunicatis  $5-7 \mu$  in diam. compositus.

Apothecia substipitate, single or crowded, emerging from black hyphae on the stem of the host between the leaves, superficial, 0.5-1 mm. in diameter, at first depressed-globose, opening by splitting from the apex into 8-10 lobes and expanding into a plane or convex disk surrounded by the stellate lobes of the exciple, fleshy-leathery, exterior bone brown<sup>1</sup> at the base, cinnamon brown to clay-color on the marginal lobes, hymenium yellowish citrine or old gold to light brownish olive, drying Natal brown to bone brown; asci cylindrical-clavate, long-pedicellate, 8-spored,  $90-110 \times 8-11 \mu$ ; spores in the upper part of the ascus, obliquely uniseriate below to biseriate above, ellipsoid-ovoid, straight or slightly curved, unicellular, biguttulate, granulose, hyaline to yellowish,  $9-11 \times 3-5 \mu$ ; paraphyses hyaline, fine, filamentous, flexuous, branched, exceeding the asci, swollen and greenish at the apex; hypothecium subhyaline to pale brown, plectenchymatic,  $100-150 \mu$  thick, extending over the inner surface of the marginal lobes; cortex pseudoparenchymatic, composed of black, thick-walled, angular to subcircular cells  $5-7 \mu$  in diameter.

On branchlets of *Libocedrus decurrens* Torr., California; along the Middle Fork of the Smith River, Del Norte Co., Mar.-Apr. 1936, H. E. Parks 5604; Nov. 1937, 6120; Jan. 1938, 6039, 6121, and 6134 (Type).

The dark, fleshy exciple and stellate opening are characters which place this genus in the Tryblidiaceae, although in Nannfeldt's classification it seems more closely related to the genera included in the section Encoelioideae of the Helotiaceae. Among genera of the Tryblidiaceae the fungus resembles *Heterosphaeria* in its splitting into lobes, but differs from the latter in the thick hypothecial layer made up of very thin, delicate, interwoven

<sup>1</sup> Color nomenclature is that of Ridgway, R. Color standards and color nomenclature. Washington, 1912.

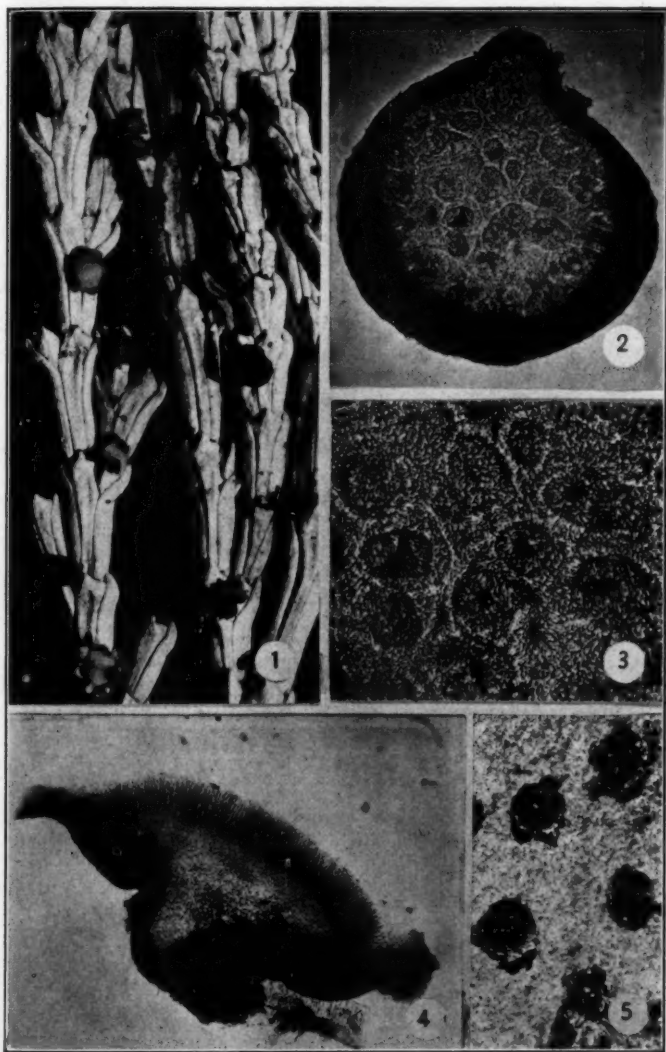


FIG. 1, *Parksia Libocedri* and *Camaropycnis Libocedri* on *Libocedrus decurrens* ( $\times 4$ ); 2, *Camaropycnis Libocedri*, section of pycnidium ( $\times 55$ ); 3, detail of 2 ( $\times 125$ ); 4, *Parksia Libocedri*, section of apothecium ( $\times 55$ ); 5, *Trybliella magnispora* on *Libocedrus decurrens* ( $\times 8$ ).



hyphae, while in *Heterosphaeria* the tissue is prosenchymatous, composed of elongate cells with cartilaginous to gelatinous thickened walls. The structure of the apothecium in *Parksia* is similar to that of *Tryblidiopsis*; the latter differs, however, in the large asci, the large two-celled spores, which are surrounded by a gelatinous sheath, and in the apothecia emerging from beneath the bark.

## 2. *Camaropycnis* gen. nov.

Pycnidia superficialia, subglobose, ostiolata, levia, carnos-coriacea, e parietibus tenuibus in loculos multos, subsphaericales divisa; conidia hyalina, unicellularia, e conidiophoribus hyalinis, subulatis, singulatim oriunda.

Pycnidia superficial, subglobose, ostiolate, smooth, fleshy-leathery, divided by thin walls into many subglobose locules; conidia hyaline, unicellular, borne singly on unbranched, hyaline, subulate conidiophores.

### *Camaropycnis Libocedri* sp. nov. (FIG. 1, 2, and 3)

Pycnidia superficialia, sessilia vel substipitata, subglobose, levia, atro-brunnea, 0.7-1 mm. in diametro et altitudine, ostiolata, carnos-coriacea, in loculos numerosos subsphaericales 50-100  $\mu$  in diam. divisa; conidiophora simplicia, eseptata, tenuia, subulata, 5-6  $\times$  0.5-0.7  $\mu$ ; conidia cylindrica, hyaline, unicellularia, 14-15  $\times$  2-2.5  $\mu$ .

Pycnidia superficial, sessile to substipitate, developing from a black, felty hyphal base embedded between the leaves of the host, subglobose or depressed-globose, nearly smooth and bone brown to Natal brown when moist, black and much wrinkled, furrowed or pitted when dry, 0.7-1 mm. in height and diameter, fleshy to leathery; ostiole papillate, apical or excentric, usually single, but occasionally two to a single pycnidium; wall 25-35  $\mu$  thick, the outer layer black pseudoparenchymatous, of small, angular, thick-walled cells, 5-10  $\mu$  in diameter, the underlying layers hyaline, gradually changing to a plectenchymatous tissue which fills the stem-like base and divides the interior of the pycnidium into many layers of subspherical locules 50-100  $\mu$  in diameter; conidiophores lining the locule walls, unbranched, continuous, thin, delicate, subulate, 5-6  $\times$  0.5-0.7  $\mu$ ; conidia borne singly, cylindrical, hyaline, unicellular, rounded at the ends, 14-15  $\times$  2-2.5  $\mu$ , contents granulose; walls of the locules extremely delicate and evanescent, leaving the conidia aggregated into closely compact, globular masses; spore globules after expulsion from the ostiole often collecting on the exterior and giving the pycnidium a white-dotted appearance.

On branchlets of *Libocedrus decurrens* Torr., California: along the Middle Fork of the Smith River, Del Norte Co., Mar.-Apr. 1936, H. E. Parks 5604-A; Nov. 1937, 6120-A; Jan. 1938, 6039-A, 6121-A, and 6134-A (Type); June 1939 and Jan. 16, 1945 (un-numbered); Palomar, San Diego Co., May 6, 1939, C. L. Shear.

The development of *Camaropycnis Libocedri* on the same branchlets as the ascomycete, *Parksia Libocedri*, from a similar black hyphal base embedded between the leaves, and the resemblance of the dark cortex and thick hyaline underlying tissue in the two fungi, suggest that they may possibly be stages in the life history of a single species. Cultures from these specimens, however, failed to develop, and there is therefore no cultural evidence that the fungi are related.

A stipitate discomycete frequently found on the same twigs with both *Parksia Libocedri* and *Camaropycnis Libocedri* has been tentatively referred to *Kriegeria*. In macroscopic appearance and the shape and dimensions of the spores it agrees with *K. Jacksoni* Seaver (*Chloroscypha Jacksoni* Seaver) which has been recorded, however, only on species of *Thuja*. It is possible that the fungus may be *Peziza alutipes* Harkn. (*Phialea alutipes* (Harkn.) Sacc.), but no material of this species has been available for comparison. The type is not in the Harkness Herbarium at the California Academy of Sciences in San Francisco, and the identity of the species can not be definitely determined.

### 3. *Trybliidiella macrospora* Bonar & Cash, sp. nov. (FIG. 5)

Apothecia erumpentia, sessilia, singula vel 2-3-caespitosa, carnosio-coriacea, atra, depresso-globosa,  $0.7-1 \times 0.5-1$  mm.,  $0.5-0.7$  mm. alta, rima longitudinali vel 3-4 lobis aperientia; asci late clavati, breviter stipitati,  $150-230 \times 55-65 \mu$ , apice crasse tunicati, plerumque 8-spori, rarius 2-4-spori; ascospores 2-3-seriatae, fuscae, uniseptatae, late ellipsoideae, medio constrictae,  $50-70 \times 25-33 \mu$ ; paraphyses numerosae, filiformes, in epithecium fuscum agglutinatae; hypothecium prosenchymaticum, brunneum, e strato plectenchymatico, crasso, subhyalino distincte definitum; cortex ater, coriaceus, pseudoparenchymaticus.

Apothecia sessile, erumpent from a stromatic base beneath the bark, closely and evenly distributed, either singly or in groups of two to three, fleshy-leathery, black, round to elliptical in outline,  $0.7-1 \times 0.5-1$  mm. by  $0.5-0.7$  mm. high, opening by a longitudinal

slit or more often by three or four lobes, margin inrolled, lobate; exciple consisting of a black, leathery layer  $25-40\ \mu$  thick, pseudoparenchymatous on the surface, merging into a thick, subhyaline plectenchyma up to  $150\ \mu$  thick near the base, narrower toward the margin; hypothecial layer prosenchymatic, brown, sharply defined from the underlying plectenchyma; asci broad-clavate, short-stipitate,  $150-230 \times 55-65\ \mu$ , the wall gelatinous and thickened at the apex to  $10-15\ \mu$ , opening by a pore, 8- (rarely 2- or 4-) spored; ascospores irregularly 2-3-seriate, dark brown, uniseptate, broad ellipsoid, constricted at the septum, each cell with a conspicuous flask-shaped gutta, germinating spores with a hyaline papilla at each end,  $50-70 \times 25-33\ \mu$ ; paraphyses numerous, filiform, much branched, dark brown at the apex and agglutinated into a thick epithecium.

On bark of *Libocedrus decurrens* Torr., California: Pineridge, Fresno Co., Sept. 6, 1921, L. Bonar (*Type*); Stanislaus National Forest, Tuolumne Co., June 3, 1941, C. R. Quick; Feather River Experiment Station, near Quincy, Plumas Co., Oct. 15, 1917, E. P. Meinecke; Palomar, San Diego Co., May 5, 1939, C. L. Shear.

The fungus is closely related to *Caldesia Sabinae* (De Not.) Rehm described on *Juniperus* in Europe, from which it differs in the much larger spores, as well as in the host. In European material examined the largest spores found were  $38\ \mu$  long, while the shortest in the California specimens measured  $50\ \mu$ , ranging up to  $70\ \mu$  in length.

Von Hoehnel (2) has pointed out that *Tryblidium Sabinae* De Not. does not belong to *Caldesia* Trevisan, which is a genus of lichens, and that *Caldesia* in the sense of Rehm is therefore invalid as a generic name. Von Hoehnel referred *Caldesia Sabinae* (De Not.) Rehm to *Eutrybliella*, raising Rehm's section to generic rank to include the species of *Trybliella* having two-celled spores. Later Nannfeldt (3, p. 333-334) combined the species as *Trybliella Sabinae* (De Not.) Nannf., placing both *Eutrybliella* (Rehm) Hoehn. and *Caldesia* Rehm (non Trev.) as synonyms of *Trybliella*. It is also stated by Butler (1, p. 821) that *Caldesia Sabinae* "is without doubt closely related to *Trybliella rufula*."

For the present, the new species on *Libocedrus* is referred to *Trybliella* in conformity with the disposition of the allied species,

*T. Sabinae*. The spores and asci of both species are unquestionably similar to those species of that genus with two-celled, constricted spores, like *T. hysterina* (Duf.) Shear. In both *T. Sabinae* and *T. macrospora* the apothecia are more deeply seated in the host, emerging only slightly abover the surface of the bark, not superficial and substipitate as is often the case in mature apothecia of *Tryblidiella*. The splitting of the apothecial margin is also different from that described for species of the genus. The even margin of *Tryblidiella* is a feature noted by Rehm (4, p. 233) as contrasted with the lacerate opening of *Tryblidium*. It is a question, therefore, whether *Caldesia* sensu Rehm should not be given a new name and retained as a distinct genus.

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# OBSERVATIONS ON CERTAIN SPECIES OF USTILAGO ON HILARIA, STENOTAPH- RUM, AND MUHLENBERGIA<sup>1</sup>

GEORGE W. FISCHER AND ELISA HIRSCHHORN<sup>2</sup>

(WITH 2 FIGURES)

*USTILAGO AFFINIS* Ellis & Ev. In Cockerell, T. D. A., Bull. Torrey Club 20: 297. 1893.

*Ustilago Stenotaphri* P. Henn. Hedwigia 37: 293. 1898.

*Ustilago Stenotaphri* Mass. Kew Bull. 1899: 184. 1899.

*Ustilago americana* Speg. Anal. Mus. Nac. Buenos Aires 6: 207. 1899.

*Ustilago Henningsii* Sacc. & Syd. In Sacc. Syll. Fung. 16: 368. 1902.

Sori in the inflorescence 4-10 mm. long, dark-brown, very dusty, soon exposing the naked rachis, but at first covered with a thin, very fragile, grayish membrane (FIG. 2, B).

Spores clear yellowish-brown, globose or irregularly globose to ovoid, or somewhat angular, 4-7  $\mu$  in diameter, or 4-5  $\times$  7-8  $\mu$ ; epispore very thin, smooth (FIG. 1, F).

On Graminaeae:

*Stenotaphrum glabrum* Trin. Argentina: Uruguay.

*Stenotaphrum secundatum* (Walt.) Kuntze. Puerto Rico.

*Ustilago affinis* var. *Hilariae* (P. Henn.) G. W. Fisch. & Hirsch. comb. nov.

<sup>1</sup> Investigations of the smut diseases of grasses, cooperative between the Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, and the Washington Agricultural Experiment Station, Pullman, Washington. Published as Scientific Paper No. 600, College of Agriculture and Agricultural Experiment Station, State College of Washington.

<sup>2</sup> Pathologist, Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, and Assistant in Plant Pathology, State College of Washington, respectively.

*Ustilago Hilariae* P. Henn. Hedwigia 37: 267. 1898.

Spores yellowish brown to brown, globose to subglobose, 6-9  $\mu$  in diameter, or 6-7  $\times$  9-10  $\mu$ ; epispore thin, punctate to slightly echinulate (FIG. 1, E and 2 A).

On Gramineae:

*Hilaria Belangeri* (Steud.) Nash. U. S.: Texas.

*Hilaria cenchroides* H.B.K. U. S.: Texas, New Mexico.

Ellis and Everhart's original description (5) of *Ustilago affinis* is very meager, so much so in fact that the species is almost a *nomen nudum*. However, subsequent descriptions by Clinton (3, 4) and others seem to have established a definite concept of this species. These authors all describe *U. affinis* as having smooth spores.

*Ustilago affinis* has been considered as attacking *Hilaria* and *Stenotaphrum*. In the material which we have examined we find consistently that on *Stenotaphrum* the spores are smooth (FIG. 1, F) and on *Hilaria* they are punctate to minutely echinulate (FIG. 1, E) as seen under oil immersion.

Hennings (7) considered the *Hilaria* smut as distinct and gave it the name *U. Hilariae* with the following description: "Soridis in spiculis, atris, membrana alkida subvelatis; sporis subglobosis, flavo-brunneolis 1-2 guttulis 6-8  $\mu$ , episporis levi, brunneo. Mexico, bei der Stadt Mexico in Aehren von *Hilaria cenchroides* Oct. 1896. (Holway)."

Hennings' *Ustilago Hilariae* has been considered by other investigators as a synonym of *U. affinis*, probably on the basis of Hennings' description of the spores as smooth, and also their failure to examine with the oil immersion lens. Since, however, we find that the spores on *Hilaria* are punctate to slightly echinulate, besides being slightly larger and darker, we are inclined to consider the smut on *Hilaria* as a different entity and have accordingly proposed the variety named above. Since the specimens on *Hilaria* correspond quite well to Hennings' *U. Hilariae* we have used his name for the variety.

According to Spegazzinni (10) and Ciferri and Herter (1), *Ustilago Stenotaphri* McAlp. (9) is another synonym of *U.*

*affinis*. It is clearly evident, however, from McAlpine's description and illustrations of his species that it cannot possibly be included in the synonymy of *U. affinis*. It appears that McAlpine's *U. Stenotaphri* is a valid species with large irregular dark-brown spores,  $10-13 \times 16-17 \mu$ .

Specimens examined: on *Hilaria Belangeri*, San Antonio, Texas, 5-16-41, leg. H. W. Johnson, fid. G. W. Fischer No. 358, Myc. Coll. Bur. Pl. Ind. No. 85212; on *H. cenchroides*, Dublan, Mexico, 9-4-05, Griffiths' Coll. in Brooklyn Bot. Gard. Herb.; *ibid.*, Spofard, Texas, 5-8-05, Griffiths' Coll. in Brooklyn Bot. Gard. Herb.; on *H. Belangeri*, San Antonio, Texas, 4-24-40, in Myc. Coll. Bur. Pl. Ind.; *ibid.*, Sonora, Texas, 7-16-36, in Myc. Coll. Bur. Pl. Ind.; on *Stenotaphrum secundatum*, Dries, Puerto Rico, 6-4-37, in Myc. Coll. Bur. Pl. Ind.; *ibid.*, San Juan, Puerto Rico, 1-19-43, leg. and fid. L. J. McConnell, San Juan No. 8465.

USTILAGO MUHLENBERGIAE P. HENN. AND USTILAGO  
MUHLENBERGIAE CLINT.

During a recent study of herbarium material under the designation of *Ustilago Muhlenbergiae* P. Henn. it has become obvious that two distinct species have been distributed in the exsiccati under this name. Both species have much the same macroscopic characters, but in one the spores are clear, light brown, and prominently echinulate, especially at the poles (which are nearly hyaline). The other species has smooth, opaque, dark-brown spores provided with cap-like appendages at opposite ends or with the exospore grooved to form the unopened appendages.

In 1902 Hennings (8) described an inflorescence smut on *Muhlenbergia Pringlei* (a synonym for *M. pauciflora*) as *Ustilago Muhlenbergiae*. Hennings' original description follows:

"Soris paniculas destruentibus tumefacientibusque, oblonge ovoideis, 3-6 mm. longis, 2-3 mm. latis, diutius epidermide, flavocinerescente tectis, duris, dein atris pulverulentis; sporis globosis vix acutangulis, fuscis  $4-4.5 \mu$  diam., episporio atro-fusco, levi."

Also in the same year Clinton (2) described an inflorescence smut on *Muhlenbergia texana* as *Ustilago Muhlenbergiae*. Clinton's original description follows:



"USTILAGO MUHLENBERGIAE Clint. n. sp.—Sori in the inflorescence, ovoid to subspherical, about 3–6 mm. in length, protected by thin, semi-transparent membrane of the infected enveloping glumes, upon rupture disclosing black-brown dusty spore mass;

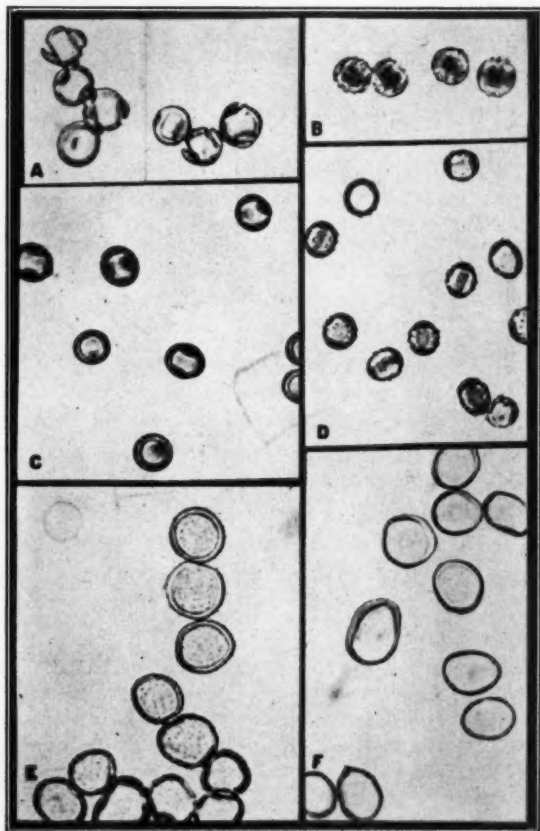


FIG. 1. A, *Ustilago Muhlenbergiae*, chlamydospores, with cap-like appendages; B, *ibid.*, without appendages open, but seen differentiated in the episporic; C, *ibid.*, without appendages open, but seen differentiated in the episporic; D, *U. hyalino-bipolaris* from *Muhlenbergia Porteri* (type material of *U. Muhlenbergiae*, ex Herb. W. G. Farlow, leg. Pringle), S. Arizona, Aug. 1884; E, *ibid.*, Santa Rita Mts. Ariz. (Griffith's Coll. No. 368, ex Herb. Brooklyn Bot. Gard.); F, *U. affinis* var. *Hilariae*, from *Hilaria Pelangeri*, Texas; G, *U. affinis*, from *Stenotaphrum secundatum*, Puerto Rico,  $\times$  approx. 1000.

spores rather dark reddish brown, chiefly spherical, with brittle epispore that breaks up into very small granular echinulations (especially at opposite sides of the spore thus leaving a darker less broken central band)  $4-6\ \mu$  in diameter.

"Host: *Muhlenbergia texana*, Ariz. (type)."

In a later work Clinton considered his binomial and Hennings' as applying to the same smut, and since Hennings' name appeared a few months earlier, priority was given to *Ustilago Muhlenbergiae* P. Henn. It seems obvious, however, that in these later works (3, 4) Clinton combines into one description of *U. Muhlenbergiae*, the characters of two species:

"... spores rather dark reddish-brown, chiefly spherical, at first apparently smooth, but with age or approaching germination splitting off caps on opposite sides of epispore and these breaking up into small granular echinulations thus leaving a dark, less broken central band,  $4-6\ \mu$  in diameter."

From the above it is apparent that there are two distinct smuts under consideration. The one, with the smooth, dark, opaque, appendaged spores (FIG. 1, A), corresponds most closely to *Ustilago Muhlenbergiae* P. Henn. and the other with echinulate spores, hyaline at opposite poles (FIG. 1, B and D) to *U. Muhlenbergiae* Clint. Hennings makes no mention of appendages in his description and it seems desirable to amend his description accordingly:

USTILAGO MUHLENBERGIAE P. Henn. Hedwigia 41: 71. 1902.  
Amend.

Sori in the abortive inflorescence, black, somewhat gall-like, with a thin hyaline membrane of host tissue, more or less indurate.

Spores dark reddish-brown, opaque, globose to subglobose,  $4-6\ \mu$  in diameter; epispore smooth, but provided more or less with a definite pattern of grooves which often form cap-like appendages at opposite poles (FIG. 1, A and C and FIG. 2, D).

On Gramineae:

*Muhlenbergia pauciflora* Buckl. (*M. Pringlei* Scribn.). New Mexico.

*Muhlenbergia* sp. Arizona.

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FIG. 2. A, *Ustilago affinis* var. *Hilariae*, on *Hilaria Belangeri*; B, *U. affinis*, on *Stenotaphrum secundatum*, normal inflorescence on extreme right; C, *U. hyalino-bipolaris*, on *Muhlenbergia Porteri*; D, *U. Muhlenbergiae*, on *M. Pringlei* (*M. pauciflora*). Approximately natural size.

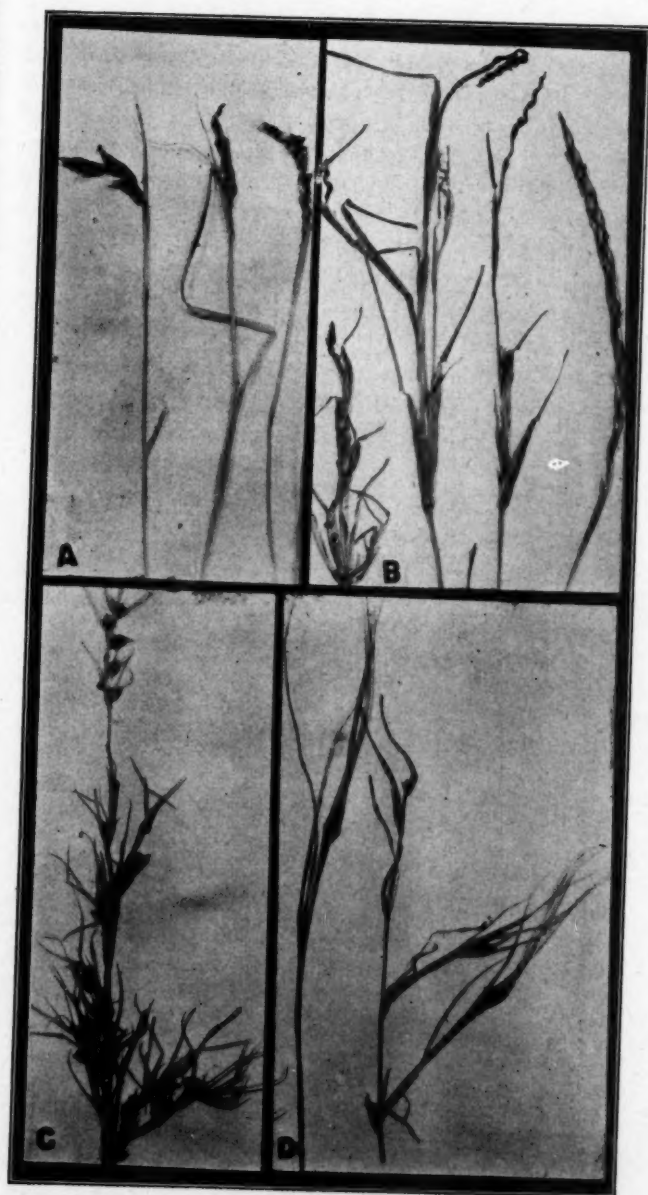


FIG. 2.

In the specimens examined there appear to be two variations of the epispore. On one, the appendages are well separated from the spore (FIG. 1, A) and are very reminiscent of *Ustilago Williamsii* (Griff.) Hirsch. and G. W. Fisch., a stem smut on *Stipa* and *Oryzopsis* (6). In the other type the cap-like appendages seem outlined on the spore but they have not separated from the spore itself (FIG. 1, C). This latter type seems to correspond more closely to Hennings' original description. In fact, the latter type is observed in the exsiccati which corresponds to the type material, if it is not actually so (Seymour and Earle, "Economic Fungi," Supplement C, edited by G. P. Clinton, No. C142, on *Muhlenbergia Pringlei*, Hot Springs, New Mexico, Sept. 15, 1896).

The other smut species on *Muhlenbergia*, with the echinulate spores, is Clinton's *Ustilago Muhlenbergiae*, but since this binomial is already occupied it becomes necessary to propose a new name:-

***Ustilago hyalino-bipolaris*** G. W. Fisch. & Hirsch. nom. nov.  
*Ustilago Muhlenbergiae* Clint. Jour. Myc. 8: 133. 1902.

Sori in the abortive inflorescence, dark-brown to black, gall-like, with thin, fragile, transparent membrane of host tissue, granular to somewhat indurate (FIG. 2, C).

Spores pale yellowish to hyaline at the poles, leaving an equatorial brown to dark brown band, globose to subglobose, often appearing laterally compressed to concave, 4-4.5  $\mu$  in diameter; epispore echinulate, especially at the clear, lighter-colored polar areas, echinulations less pronounced in the central dark band, and sometimes appearing arranged in rows (FIG. 1, B and D).

On Gramineae:

*Muhlenbergia Porteri* Scribn. Arizona, New Mexico.

These two small-spored species of *Ustilago* on *Muhlenbergia* are very similar macroscopically (FIG. 2, C and D), but are readily distinguished by their microscopic characters. Since both are gall-like in the abortive inflorescence and have nearly the same hosts, it would be easy to confuse the two without microscopic examination.

Specimens examined: on *Muhlenbergia* sp., foothills of the San Francisco Mts., Flagstaff, Ariz., Biol. Explorations U. S. Dept. Agr., Death Valley (California) Expedition No. 9, 12-23-1890

(originally determined as *Ustilago microspora* Ellis & Gall., then crossed out and labeled *U. minima* Arth., in same handwriting); on *M. pauciflora* (*M. Pringlei*), Hot Springs, New Mex., 9-15-1896, in Seymour and Earle, Economic Fungi, Supplement C, edited by G. P. Clinton, No. C142, Coll. E. W. D. Holway; on *M. ? Porteri*, Santa Rita Mts., Ariz., Griffiths' Coll. 368, in Herb. Brooklyn Bot. Gard.; *ibid.*, Las Cruces, New Mex., Griffiths' Coll. No. 255, Oct. 5, 1904, in Herb. Brooklyn Bot. Gard.; *ibid.*, S. Arizona, Aug. 1884, Coll. Pringle, in Herb. W. G. Farlow (type material of *Ustilago Muhlenbergiae* Clint. = *U. hyalino-bipolaris* G. W. Fisch. & Hirsch.).

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## A NEW RHABDOGLOEUM ASSOCIATED WITH RHABDOCLINE PSEUDOTSUGAE IN THE SOUTHWEST

DON E. ELLIS AND LAKE S. GILL<sup>1</sup>

(WITH 2 FIGURES)

In 1922 Sydow (4) described *Rhabdocline Pseudotsugae* Syd. and *Rhabdogloeum Pseudotsugae* Syd. on Douglas-fir (*Pseudotsuga taxifolia* (Poir.) Britt.) from Montana and suggested that the latter is the imperfect stage of the former. A review of the literature reveals only a few references to *Rhabdogloeum* since that time. Dearness (2) reported its presence in a collection from Colorado and at the same time described *Rhabdogloeum abietinum* Dearness on *Abies Fraseri* (Pursh) Poir. from North Carolina. Wilson and Wilson (6) report the occurrence of a conidial stage of *Rhabdocline* that develops in late summer on the upper surface of Douglas-fir needles in America but state that it has not been found in Scotland. Van Vloten (5) considers their imperfect fungus to be *Rhabdogloeum Pseudotsugae* but does not believe it is linked with *Rhabdocline*.

In May 1939, a disease of 1-year-old (1938 origin) Douglas-fir needles, which appeared to be the needle blight caused by *Rhabdocline Pseudotsugae*, was observed in the Graham Mountains, near Safford, Arizona. Examination of the diseased needles revealed the presence of an imperfect fungus that, in some respects, resembled *Rhabdogloeum Pseudotsugae* (3). Needles collected from the same trees about one month later (June 1939) bore fruits of *Rhabdocline Pseudotsugae*, as well as the imperfect fungus. The disease was observed again in the same locality in May 1940.

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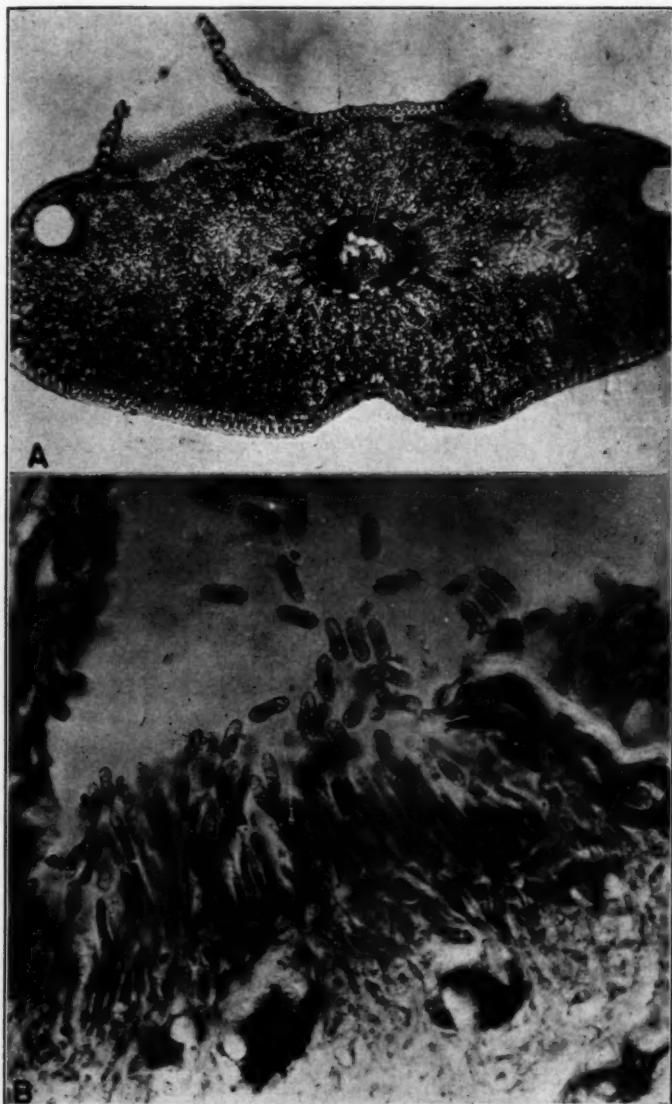


FIG. 1. A, cross section through Douglas-fir needle, showing acervuli of *Rhabdogloeum hypophyllum*, approximately  $\times 75$ ; B, cross section through an acervulus, showing conidia and conidiophores, approximately  $\times 760$ .

In January 1940, a needle blight that was also similar to the disease caused by *Rhabdocline* was observed on the needles of 1939 origin on young Douglas-fir trees in the Lincoln National Forest near Cloudcroft, New Mexico. No fungus was observed fruiting at that time, but needles from several trees that were placed in moist chambers and kept at room temperature in the laboratory developed numerous acervuli on their lower surfaces within one week. A collection made from the same trees early in March showed the presence of the same imperfect fungus (FIG. 1). Needles from this material, which were kept in a moist chamber at 15–17° C. for about one month, developed mature fruits of *Rhabdocline*. This test was repeated several times during the spring and invariably the imperfect fungus would be supplanted by the perfect one. Additional collections from the same general locality were made at approximately 15-day intervals during March, April, and May. These showed a steady increase in abundance of the imperfect fungus until May when *Rhabdocline* appeared in nature together with conidial form. An additional collection (called to our attention by G. G. Hahn), made by J. S. Hall in the same area in June, was examined and found to contain both mature fruits of *Rhabdocline Pseudotsugae* and the imperfect fungus.

Observations on specimens kept in moist chambers and on material undergoing transition in nature indicate that the asci can originate beneath the conidial layer in the same fruiting structure, apparently forcing the latter out and replacing it as shown in figure 2.

Van Vloten (5) considers *Rhabdocline* to be an obligate parasite and states that he was unable to grow it artificially. We have not attempted to culture *Rhabdocline* but have successfully grown the conidial fungus on artificial media. It was isolated from the diseased needles collected in January 1940, and from each subsequent collection during the spring. The needles were surface-sterilized for two minutes in 1:1000 mercuric chloride, washed in sterile water, and planted on agar. Colonies that developed within the first few days were usually contaminants and had to be discarded. In the case of successful isolations, the hyphae usually issued from the necrotic spots of the leaf after eight or nine days, and not until about a week later did the colonies spread out into the

agar. Subsequent growth was very slow and irregular, the colonies attaining a maximum diameter of only about 18 mm. in one month. The fungus grew on malt, corn meal, and Douglas-fir needle decoction agars, the best results having been attained on the latter. Mycelial growth was sparse, but conidia were produced in abundance, accumulating in masses that formed the most conspicuous part of the colony. On malt agar the colonies were at first white, but with age passed through deepening shades of gray until after one or two months they usually turned dark olive green. Single-spore isolations of conidia produced in culture gave rise to the same type of growth. Although no critical temperature tests have been run, preliminary trials indicate that better growth takes place at room temperature than at temperatures ranging from  $1^{\circ}$  to  $17^{\circ}$  C.

The conidia produced in culture are similar to those produced in nature, but in cultures three or more weeks old they are commonly somewhat more constricted in the middle. They often become two-celled at maturity and bear a rather striking resemblance to ascospores of *Rhabdocline*. In old cultures they frequently become thick-walled and dark-colored. In the case of septate spores, one cell often turns dark and the other remains hyaline. Wilson and Wilson (6) noted the same condition in mature ascospores of *Rhabdocline* and state that usually only the dark cell germinates. The conidia usually produce only one germ tube although two-celled spores may produce two. Germination of both hyaline and colored spores has been observed.

The imperfect fungus observed in Arizona and New Mexico resembles *Rhabdogloeum Pseudotsugae* in some respects but the spores are somewhat smaller, the conidiophores are considerably longer, and the underlying hyphal layer from which the conidiophores arise is thicker and more conspicuous. The conidiophores probably more closely resemble those of *R. abietinum* which, according to Dearness (2), are about  $45\ \mu$  long. In describing *R. Pseudotsugae*, Sydow (4) states, "Konidienträger undeutlich, sehr zart, stäbchenförmig, ca.  $7-12 \times 1.5\ \mu$ " whereas in our fungus the conidiophores are prominent,  $10-56 \times 0.9-2.8\ \mu$  (average  $28.3 \times 1.8\ \mu$ ). His spore measurements are  $15-21 \times 4-5\ \mu$ , whereas ours are  $6.7-11.1 \times 2.2-3.7\ \mu$  (average  $9.1 \times 3\ \mu$ ). We have examined

a portion of the type collection of *R. Pseudotsugae*, as deposited in the Mycological Collections of the Bureau of Plant Industry, Soils, and Agricultural Engineering, and found conidiophores  $6.1\text{--}14.8\ \mu$  (average about  $10.1\ \mu$ ) long and conidia  $10.7\text{--}17 \times 2.9\text{--}4.6\ \mu$  (average about  $14.2 \times 3.6\ \mu$ ). In examining an additional collection (No. 361 Herbarium J. S. Boyce) of *R. Pseudotsugae* from California we found it to conform closely to the type, with conidiophores  $6.2\text{--}14.8\ \mu$  (average about  $9.6\ \mu$ ) long and conidia  $11.1\text{--}18.6 \times 2.8\text{--}5.0\ \mu$  (average about  $14.1 \times 3.9\ \mu$ ). Fruiting bodies were observed on both sides of the needles in the type, but on the upper surface only in the California collection, while in our material fruiting is mainly on the lower, only rarely on the upper surface. The writers, therefore, believe that the conidial form found associated with *Rhabdocline* in the Southwest is not *Rhabdogloeum Pseudotsugae* and, in as much as its connection with *Rhabdocline* has not been conclusively established, should be regarded as a new *Rhabdogloeum*, which is described as follows:

***Rhabdogloeum hypophyllum* sp. nov.**

Fruiting bodies hypophyllous, rarely epiphyllous, in reddish-brown conspicuous spots, scattered or confluent, often in parallel series on either side of the midrib,  $130\text{ to }500\ \mu$  wide by  $35\text{ to }150\ \mu$  high, average about  $300 \times 90\ \mu$ , raising the epidermis into elongate pustules  $0.5\text{ to }4\text{ mm.}$  long, at first covered, later erumpent. Conidia, hyaline, continuous, oblong, straight to slightly curved, often somewhat constricted near the middle,  $6.7\text{--}11.1 \times 2.2\text{--}3.7\ \mu$ , average  $9.1 \times 3\ \mu$ . Conidiophores slender, simple, continuous or septate,  $10\text{--}56 \times 0.9\text{--}2.8\ \mu$ , average  $28.3 \times 1.8\ \mu$ .

Acervuli hypophylli, rare epiphylli, dispersi vel confluentes, saepe in seriebus parallelibus dispositi, primum tecti et epidermidem in pustulis elongatis  $0.5\text{--}4\text{ mm.}$  longis elevantes, dein erumpentes,  $130\text{--}500\ \mu$  lati,  $35\text{--}150\ \mu$  alti; conidia hyalina, continua, oblonga, recta vel subcurvata, saepe medio aliquantus constricta,  $6.7\text{--}11.1 \times 2.2\text{--}3.7\ \mu$ ; conidiophora tenuia, simplicia, continua vel septata,  $10\text{--}56 \times 0.9\text{--}2.8\ \mu$ .<sup>2</sup>

Parasitic on needles of *Pseudotsuga taxifolia* (Poir.) Britt.: Arizona; New Mexico.

Type locality: Lincoln National Forest, near Cloudcroft, New Mexico.

<sup>2</sup> Latin description prepared by Miss Edith K. Cash, Associate Mycologist, Division of Mycology and Disease Survey, Bureau of Plant Industry, Soils, and Agricultural Engineering.

Specimens examined: The following specimens in the herbarium of the Division of Forest Pathology at Albuquerque, N. Mex., were examined:

Arizona.—Crook National Forest: Hospital Flat, Graham Mountains, D. E. Ellis, May 13, 1939 (89324), June 21, 1939 (89314), May 9, 1940 (89386).

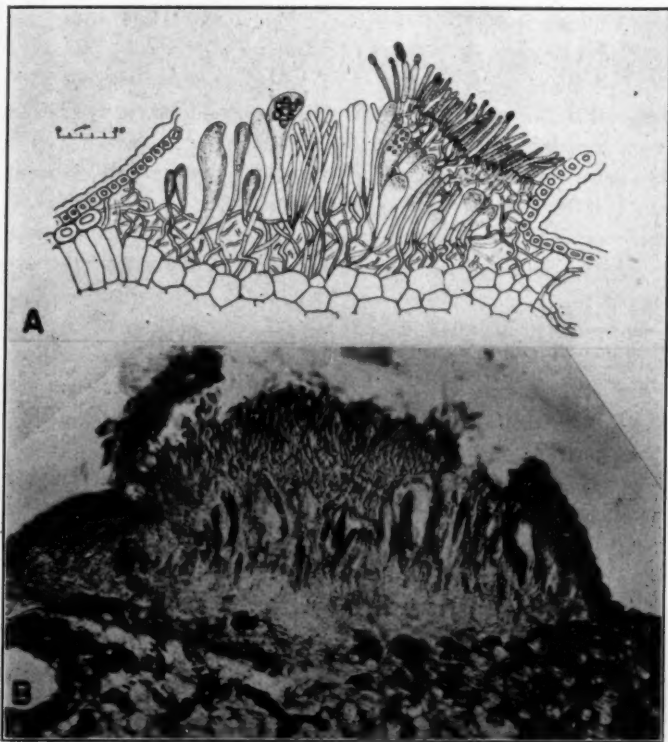


FIG. 2. A, camera-lucida sketch from free-hand section through a fruiting body undergoing transition from the imperfect to the perfect stage. The remnants of the conidial stroma are shown on the right being pushed out by the developing asci. B, photomicrograph of a section through a fruiting body undergoing transition from the imperfect to the perfect stage somewhat less advanced than in figure 2 A. In this case the conidial layer is to the left and the ascogenous layer is just below, the asci being in a very early stage of development.

New Mexico.—Red River, R. K. Beattie and L. S. Gill, May 14, 1940 (89391). Lincoln National Forest: near Cloudcroft, L. S. Gill and D. E. Ellis, January 13, 1940 (89371), March 4, 1940 (89374), J. S. Hall, March 18, 1940 (89376), April 16, 1940 (89383), June 15, 1940 (92530), D. E. Ellis, May 23, 1940 (89392); James Canyon, L. S. Gill and J. S. Hall, April 4, 1940 (89380); Sacramento River, J. S. Hall, April 30, 1940 (89384); near Cloudcroft Nursery, L. S. Gill and G. G. Hahn, May 13, 1942 (89639), *type*.

A portion of the type collection is being deposited with the Mycological Collections of the Bureau of Plant Industry, Soils, and Agricultural Engineering.

It seems improbable, as Boyce (1, p. 171) has already pointed out, that *R. Pseudotsugae* is the imperfect stage of *Rhabdocline Pseudotsugae*, because the former is collected so seldom and has only been found in nature after the fruiting bodies of the latter are mature.

The work on this problem has been interrupted and the writers fully realize that additional critical studies will be necessary before definite conclusions can be drawn. However, it is felt that the above observations strongly suggest that *Rhabdogloeum hypophyllum*, which has been repeatedly found associated with *Rhabdocline Pseudotsugae* in the Southwest and successfully grown in artificial culture, is a stage in the life history of that organism.

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## PHOTOGRAPHS AND DESCRIPTIONS OF CUP-FUNGI—XXXIX. THE GENUS GODRONIA AND ITS ALLIES

FRED J. SEAVER

(WITH 3 FIGURES)

There seems to be much difference of opinion in the minds of mycologists as to the taxonomic status of the genus *Godronia* and its close allies. Far be it from the present writer to attempt to solve all the intricate nomenclatural problems involved but perhaps it is not out of place at this time for us to make our little contribution to the confusion already existing in an effort to bring together all the facts as viewed by a taxonomist.

The genus *Godronia* was founded by J. B. Mougeot (Consid. Gen. Veg. Vosges 355. 1845) and based on *G. Muhlenbeckii*, a species which seems not to be very well known. The characters of the genus however were well defined. Several years later the genus *Crumenula* was proposed by DeNotaris (Comm. Soc. Critt. Ital. 1: 363. 1863) based on *Peziza Urceolus* Alb. & Schw. In 1885 Karsten (Acta Fauna Fl. Fenn. 2: 143) made *Crumenula* a synonym of *Godronia*.

Rehm (Rab. Krypt.-Fl. 1<sup>a</sup>: 237. 1896) retains both genera but transfers the type of *Crumenula* to *Godronia*, a procedure which would not be sanctioned under present day rules and practices. From that day on *Peziza Urceolus* has been regarded as the type of the genus *Godronia*. Those who have attempted to keep the two genera *Crumenula* and *Godronia* segregate them on the fact that the former has apothecia with a slightly tomentose or hairy exterior, while in the latter they are smooth, a character which would not appear to be of great importance. In 1863 DeNotaris also established the genus *Scleroderris* (Comm. Soc. Critt. Ital. 1: 383), based on *Peziza ribesia* Pers. At the present time mycologists are generally agreed that *Godronia* and *Scleroderris*

are synonymous. Nannfeldt goes a step farther (Nova Acta Soc. Sci. Upsal. IV. 8: 282. 1932), combining *Godronia*, *Crumenula*, *Scleroderris* and *Durandia*, but treats *Scleroderris* as the valid name, probably because the type of the genus *Godronia* is not very well-known. Since the characters of the genus were well defined we believe the name *Godronia* should be retained. If Nannfeldt is correct in reducing *Durandia*, *Durandiella* Seaver should also be included since it was proposed to replace the name *Durandia* which is untenable. Groves (Mycologia 29: 79. 1937) believes that *Durandiella* should be retained as distinct from *Scleroderris* or *Godronia*.

In 1930 a new genus was proposed by Zeller and Goodding (Phytopathology 20: 561) for certain species which had previously been referred to *Scleroderris* but which they believed to be sufficiently distinct to constitute a separate genus. They proposed *Atropellis* with *Atropellis pinicola* Zeller and Goodding as the type species. The genus was to be distinguished from *Scleroderris* and *Godronia* by the non-septate spores—a character which is extremely variable in some groups—and the color of the apothecium and hymenium. But the type of *Atropellis* is very closely related and certainly congeneric with our *Crumenula pinicola* or, at least, what has passed as that species in the eastern United States. One of the characters of our so-called *Crumenula pinicola* is the purple color of the paraphyses when crushed and seen with transmitted light.

In order to get more information on the nature of the European *Crumenula*, in January 1937 a letter was addressed to J. A. Nannfeldt of Sweden requesting material of *Crumenula*. No material was available, but later Nannfeldt sent on loan slides of *Crumenula pinicola* (Rab.) Karst., and also *Crumenula sororia* Karst. We were much interested to note that both showed with transmitted light the same blue color which characterized the American material referred to *Crumenula pinicola*. While the spore characters were not altogether satisfactory in the prepared slides, we believe that our material is identical with *Crumenula pinicola* (Rab.) Karst. The same blue character has also been observed in *Atropellis pinicola* Zeller & Goodding. This and other characters would indicate that the two are congeneric.

In 1930 Groves (*Mycologia* 28: 451. 1936) discusses *Ascocalyx Abietis* Naumov, the conidial stage of which has long been known in America. The perfect stage was collected in northern Ontario. He concludes that *Ascocalyx Abietis* is probably congeneric with *Crumenula pinicola* (Rab.) Karst., but that it is not congeneric with *Crumenula Urceolus* (Alb. & Schw.) DeNotaris. He further believes that *Ascocalyx* is a valid genus and that species of *Crumenula* in the sense of Rehm should be transferred to *Ascocalyx*.

From this it will be seen that *Godronia* is a conglomerate genus made up of several units which have been brought together because they have certain characters in common but, eventually, it may be necessary to resolve it, or partially resolve it, into its component parts. For the time being, however, they may all be regarded as *Godronia*. It is our purpose here to list and discuss a number of species which are at the present time included in the genus.

The oldest described species at the present time included in the genus is *Peziza ribesia* Pers. (Tent. Disp. Fung. 35. 1797), later made the type of the genus *Scleroderris*, characterized by its much elongated slender ascospores. Bonorden (Handb. Mykol. 135. 1864) described the conidial stage of this fungus under the name *Fuckelia*. It consists of cylindrical or conical pycnidia divided into numerous chambers containing the pycnospores  $4 \times 6.5-10 \mu$ . The pycnidia are at first closed but later burst open irregularly. Fuckel (Symb. Myc. 267. 1869) cites two conidial stages for this fungus, *Fuckelia Ribis* Bon. and *Mastomyces uberiformis* (Fries) Karst. (*Mastomyces Friesii* Mont.). Cash (*Mycologia* 26: 268. 1934) states that the former is the conidial stage of *Godronia Urceolus* (Alb. & Schw.) Karst. which often occurs on the same host which is doubtless responsible for the confusion.

The next earliest species at present considered in the genus is *Sphaeria fuliginosa* Pers. (Obs. Myc. 2: 68. 1799). A full account of this species was published by the writer (*Mycologia* 25: 55. 1933). So far as the writer is aware this species is known from only two collections in America, one by John Dearnness in Ontario which Ellis described as a new species, *Lasiosphaeria striata*, and the other by the writer in collaboration with Ells-

worth Bethel which was again described as a new species, *Godronia Betheli* Seaver. It will be noted that twice this has been described as a sphaeriaceous fungus, due to the fact that the apothecia are for a long time closed and when young resemble large perithecia. This species occurs exclusively on willow. The report of the occurrence of this species, appearing in the Host Index of the Fungi of North America, under the name *Godronia Betheli*, on alder, was an error. The fungus collected and reported by C. H. Kauffman (Papers Mich. Acad. 1: 109. 1921) is *Cyphella fasciculata*, a fungus which outwardly resembles the *Godronia* for which it was mistaken.

The pycnidia occur in congested groups accompanying the apothecia and resembling them in color. They are at first closed but seen to dehisce at maturity, forming miniature apothecial-like structures. The pynospores resemble the ascospores but are less than half as long.

The third species described which is now included in the genus is *Peziza Urceolus* Alb. & Schw. (Consp. Fung. 332. 1805), which occurs on twigs of various deciduous shrubs and trees. The pycnidial stage *Mastomyces* of this fungus has been discussed by Miss Cash (Mycologia 26: 266. 1933), the pynospores 3-4  $\times$  26-30, 3-septa.

Following is the writer's conception of the genus:

*GODRONIA* Moug. Consid. Gen. Veg. Vosges 355. 1845.

*Crumenula* De-Not. Comm. Critt. Ital. 1: 365. 1863.

*Scleroderis* (Fries) De-Not. Comm. Critt. Ital. 1: 383. 1864.

*Durandia* Rehm, Ann. Myc. 11: 166. 1913.

*Ascocalyx* Naumov, Bolesni Rast. 14: 138. 1925.

*Atropellis* Zeller & Goodding, Phytopathology 20: 561. 1930.

*Durandiella* Seaver, Mycologia 24: 261. 1932.

Type species, *Godronia Muhlenbeckii* Moug. & Lév.

Mougeot describes the genus as having apothecia which are coriaceous or gelatinous like *Bulgaria*, and with the spores of a *Stictis*. The genus *Godronia* and the genus *Stictis* are strikingly similar and might easily be confused, notwithstanding the fact that they are placed in different orders.

The genus is characterized by the erumpent apothecia and the very much elongated or filiform spores which usually become 1-

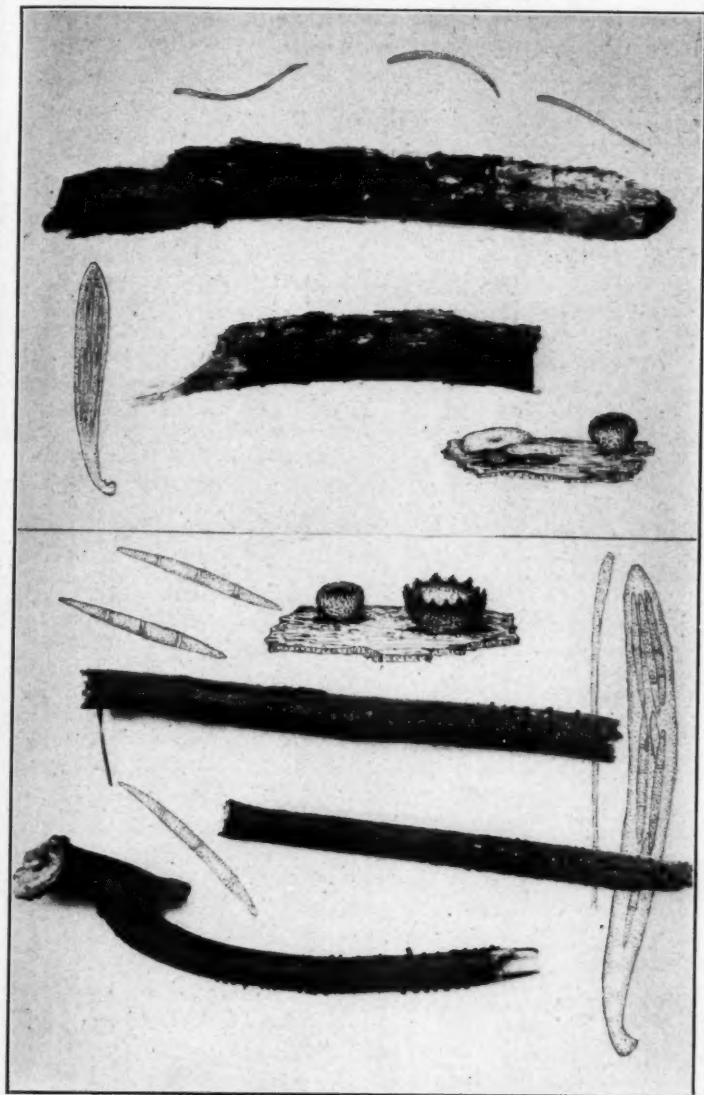


FIG. 1. Above, *Godronia Kalmiae*; below, *G. Spiraeae*.

to several-septate, although they may be for a long time without septa, as in other species of Cenangiaceae.

On deciduous woody plants.

Spores relatively short, less than half the length of the ascus.

On stems of *Ribes*.

In congested masses; spores clavate.

Spores becoming 3-septate.

Spores 20–38  $\mu$ .

Spores 18–20  $\mu$ .

Spores simple, in specimens studied.

Occurring singly; spores fusoid.

Not on *Ribes*.

Spores fusoid.

Spores 11–17  $\mu$  long; on *Lantana*.

Spores 20–24  $\mu$  long.

Apothecia turbinate; hymenium concave.

Apothecia patellate; hymenium plane or nearly so.

Spores 25–40  $\mu$  long.

Apothecia with a lacinate border on *Spiraea*; spores 3–4  $\times$  25–35  $\mu$ .

Apothecia not lacinate on *Vitis*; spores 3–4  $\times$  35–40  $\mu$ .

Spores slender, rod-like; 1.5–2  $\times$  10–12  $\mu$ .

Spores relatively long, more than half as long as the ascus.

On stems of woody plants.

Spores long-fusoid.

Apothecia deeply concave; on *Salix*.

Apothecia slightly concave; on *Betula*.

Spores filiform or vermiform.

Spores short, 25–30  $\mu$  long; on *Kalmia*.

Spores 40–75  $\mu$  long.

Spores slender, 1.5–2  $\mu$  thick.

Apothecia caespitose, discoid.

Apothecia scattered, urceolate.

Spores 3–4  $\mu$  in diameter, nearly as long as the ascus.

Apothecia scattered; on sage brush.

Apothecia in caespitose clusters.

Spores 3  $\times$  65–70  $\mu$ ; on *Cephalanthus*.

Spores 3–4  $\times$  85–100  $\mu$ .

On *Viburnum*.

On *Fraxinus*.

Spores 6  $\times$  75  $\mu$  vermiform; on *Quercus*.

1. *G. Ribis*.

2. *G. lobata*.

3. *G. tumoricola*.

4. *G. Davidsoni*.

5. *G. Lantanae*.

6. *G. turbinata*.

7. *G. fusispora*.

8. *G. Spiraeae*.

9. *G. viticola*.

10. *G. Lonicerae*.

11. *G. fuliginosa*.

12. *G. seriata*.

13. *G. Kalmiae*.

14. *G. Nemopanthis*.

15. *G. Urceolus*.

16. *G. montanensis*.

17. *G. Cephalanthi*.

18. *G. viburnicola*.

19. *G. Fraxini*.

20. *G. tabacina*.



- Spores very long, nearly as long as the ascus.  
 On leaves of *Tetrazygia*, spores  $250\ \mu$  long.  
 On branches of *Castanopsis*.  
 On coniferous branches.  
 Paraphyses blue with transmitted light.  
 Spores 1-3-septate.  
 Spores simple or doubtfully septate.  
 Spores  $1.5-3.5 \times 32-63\ \mu$ .  
 Spores  $5-6 \times 15-22\ \mu$ .  
 Paraphyses not blue.  
 Hymenium light colored.  
 Hymenium pink to brown; on *Picea* in Alaska.  
 Hymenium pale yellow or whitish; on *Juniperus* in Jamaica.  
 Hymenium grayish to black; on *Abies*.
21. *G. parasitica*.  
 22. *G. Castanopsidis*.  
 23. *G. pinicola*.  
 24. *G. Zelleri*.  
 25. *G. sororia*.  
 26. *G. Treleasei*.  
 27. *G. jamaicensis*.  
 28. *G. Abietis*.

1. *Godronia Ribis* (Fries) comb. nov.

*Peziza ribesia* Pers. Tent. Disp. Fung. 35. 1797.

*Cenangium Ribis* Fries, Syst. Myc. 2: 179. 1822.

*Tympanis Ribis* Wallr. Fl. Crypt. Ger. 2: 430. 1833.

*Crumenula Ribis* Karst. Fungi Fenn. Exsicc. 929. 1870.

*Scleroderris ribesia* Karst. Myc. Fenn. 1: 215. 1871.

Apothecia erumpent in cespitose clusters, 1-3 mm. in diameter from a stromatic base, each cluster consisting of 4-12 apothecia, individual apothecia at first globose or subglobose, short stipitate gradually expanding and becoming shallow cup-shaped, with a notched or fimbriate margin, reaching a diameter of 1-2 mm., blackish-brown; hymenium concave, pale cinereous; asci clavate-cylindric, reaching a length of  $90-100\ \mu$  and a diameter of  $7-8\ \mu$ , 8-spored; spores much elongated, clavate,  $3-4 \times 20-38\ \mu$ , becoming 3-septate; paraphyses filiform, slightly enlarged above.

Pycnidia, *Fuckelia Ribis*, present; pycnosporos elongate-clavate,  $3-4 \times 7-11\ \mu$ , usually containing two oil drops.

On branches of species of *Ribes*.

TYPE LOCALITY: Europe.

DISTRIBUTION: Toronto, Canada; also in Europe.

ILLUSTRATIONS: Boud. Ic. Myc. pl. 563; Ann. Sci. Nat. III. 20: pl. 16, f. 9-11; Tul. Fung. Carp. 3: pl. 19, f. 1-9; Rab. Krypt.-Fl. 1<sup>3</sup>: 200, f. 1-2; 201, f. 6, 7; E. & P. Nat. Pfl. 1<sup>1</sup>: 255, f. 187.



**2. *Godronia lobata* (Cash) comb. nov.**

*Scleroderris lobata* Cash, Mycologia 28: 248. 1936.

Apothecia breaking through the bark usually in clusters of 2-4 or rarely single, subglobose to cupulate, opening by splitting into 4-6 lobes which fold over one another on drying, reaching 1 mm. in diameter and height, externally blackish-brown, smooth; hymenium concave, light olive-gray; asci cylindric, short-stipitate, rounded and slightly narrowed above, reaching a length of 90-115  $\mu$  and a diameter of 7-9  $\mu$ ; spores 1-seriate below, 2-seriate above, clavate, usually 3-septate, 3-4  $\times$  18-20  $\mu$ ; paraphyses filiform, simple or branched near the tip, slightly enlarged above.

On twigs of *Ribes Menziesii*.

TYPE LOCALITY: Spruce Cove, Trinidad, California.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATIONS: Mycologia 28: 250, f. 3.

**3. *Godronia tumoricola* (Cash) comb. nov.**

*Scleroderris tumoricola* Cash, Mycologia 26: 270. 1934.

Apothecia sessile, usually cespitose or rarely single, cup-shaped to nearly plane, triangular or irregularly contorted when dry, coriaceous, blackish-brown to black, .5-2 mm. in diameter; hymenium concave to plane, drab, drying nearly black; asci cylindric, narrowed above, reaching a length of 90-100  $\mu$  and a diameter of 5-8  $\mu$ , 8-spored; spores 2-seriate or irregularly 1-seriate, clavate with the acute end below, simple (later septate?), 1.5-2  $\times$  10-15  $\mu$ ; paraphyses filiform, hyaline simple or branched near the middle, enlarged above to 2  $\mu$  in diameter.

On swollen canker-like areas on twigs of *Ribes montigenum*.

TYPE LOCALITY: Mesa Lakes, Grand Mesa National Forest, Colorado.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATIONS: Mycologia 26: pl. 32, f. 4.

This species was placed in the genus *Scleroderris* on the supposition that the spores would finally become septate although no septa were apparent in the specimens studied. The spores in other Cenangiaceae often become tardily septate.

**4. *Godronia Davidsoni* Cash, Mycologia 26: 269. 1934.**

Apothecia sessile or substipitate, single, depressed-globose to urceolate, not exceeding 1 mm. in diameter and height, dark col-

ored, greenish-olive, opening with a circular opening, with a fimbriate margin; hymenium concave, smoky-gray; asci cylindric gradually narrowed toward the base and above, 8-spored, reaching a length of 90–120  $\mu$  and a diameter of 5–7  $\mu$ ; spores acicular-fusoid, parallel or slightly twisted in the ascus, becoming 3-septate, 2.5–3  $\times$  33–45  $\mu$ ; paraphyses filiform, simple, hyaline, gradually enlarged above, reaching a diameter of 2–2.5  $\mu$ , often curved at the tips.

On stems of *Ribes Wolfii*, *R. bracteosum*  $\times$  *R. nigrum*.

TYPE LOCALITY: Near Mesa Lakes, Grand Mesa National Forest, Colorado.

DISTRIBUTION: Colorado and Alaska.

ILLUSTRATIONS: *Mycologia* 26: 269, f. A; *pl.* 32, f. 3.

5. *Godronia Lantanae* (Cash) comb. nov.

*Scleroderris Lantanae* Cash, *Mycologia* 30: 100. 1938.

Apothecia cespitose, sessile, cupulate to discoid, contorted by mutual pressure, reaching a diameter of 1–1.5 mm., furfuraceous, brown, the margin inrolled when dry, sometimes becoming hysteroid; hymenium concave to plane, brownish-black; asci clavate, rounded above, gradually narrowed toward the base, 8-spored, reaching a length of 50–55  $\mu$  and a diameter of 5  $\mu$ ; spores 2-seriate, fusoid, straight or slightly curved, becoming 1-septate, hyaline to pale brownish, 1.5–2  $\times$  11–17  $\mu$ ; paraphyses simple, 2.5  $\mu$  in diameter at their apices.

On fallen branches of *Lantana camara*.

TYPE LOCALITY: Kaluaaha Valley, Molokai, Hawaii.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: *Mycologia* 30: 99, f. 4.

6. *GODRONIA TURBINATA* (Schw.) Farlow, *Mycologia* 14: 101. 1922.

*Tympanis turbinata* Schw. Trans. Am. Phil. Soc. II. 4: 237. 1832.

Apothecia erumpent, turbinate, with the mouth strongly constricted, brownish-black, furfuraceous, reaching a diameter of 1 mm.; hymenium deeply concave, pallid; asci clavate, reaching a length of 110  $\mu$  and a diameter of 6–7  $\mu$ , apparently 8-spored; spores often indistinct, fusiform, about 2  $\times$  20  $\mu$ , 3-septate.

On twigs of *Diervillea*.

TYPE LOCALITY: Bethlehem, Pennsylvania.

DISTRIBUTION: Pennsylvania and Maine.

EXSICCATI: Reliq. Farlow. 122.

This description is based on material collected by Dr. R. Thaxter at Kittery Point, Maine. Material in the Schweinitz collection in Philadelphia is scant and uncertain.

7. *Godronia fusispora* (Ellis & Ev.) comb. nov.

*Dermatea fusispora* Ellis & Ev. Proc. Acad. Phila. 1893: 148. 1893.

Apothecia scattered, occurring singly or occasionally 2 or 3 crowded together, externally subolivaceous, reaching a diameter of 1 mm.; hymenium plane or nearly so with a slightly elevated margin, reddish; asci clavate, 8-spored, reaching a length of 70–75  $\mu$  and a diameter of 6–7  $\mu$ ; spores narrow fusoid, 2–3  $\times$  20–24  $\mu$ ; paraphyses filiform, slightly enlarged above, reaching a diameter of 2–3  $\mu$ .

On dead branches of *Betula* sp.

TYPE LOCALITY: Orono, Maine.

DISTRIBUTION: Known only from the type locality.

8. *Godronia Spiraeae* (Rehm) comb. nov.

*Scleroderris Spiraeae* Rehm in Rab. Krypt. Fl. 1<sup>3</sup>: 1220. 1896.

Apothecia subsessilis, thickly gregarious, occurring singly or rarely with two or three crowded together, subglobose, with the mouth constricted (in dried specimens) and lacinate, dark brownish-black, often with a greenish tint, reaching a diameter of 1 mm.; hymenium concave, obscured when dry by the incurved margin, freely exposed when moist, light brown; asci cylindric-clavate, reaching a length of 80–85  $\mu$  and a diameter of 6–7  $\mu$ , 8-spored; spores fusoid, overlapping and subfasciculate, 3–4  $\times$  25–35  $\mu$ , becoming 3-septate; paraphyses slender, slightly enlarged above (FIG. 1, lower).

On branches of *Spiraea salicifolia*.

TYPE LOCALITY: Hewitt's Pond, New York.

DISTRIBUTION: Known only from the type locality.

Described from material in the herbarium of The New York Botanical Garden, collected by C. H. Peck in July (the year not indicated).

9. *GODRONIA VITICOLA* (Schw.) Farlow; Thaxter, *Mycologia* **14**: 101. 1922.

*Peziza viticola* Schw. Schr. Nat. Ges. Leipzig **1**: 123. 1822.

*Cenangium viticolum* Sacc. Syll. Fung. **8**: 572. 1889.

Apothecia scattered or gregarious, scutellate to subdiscoid, black or blackish, soft and subgelatinous when moist, reaching a diameter of 15 mm.; asci clavate, tapering below into a slender stem-like base, reaching a length of  $85\ \mu$  and a diameter of  $12\ \mu$ , 8-spored; spores fusoid, 1-3-septate,  $4 \times 35-40\ \mu$ ; paraphyses filiform.

On bark of living grape vine, *Vitis* sp.

TYPE LOCALITY: North Carolina.

DISTRIBUTION: North Carolina to New Jersey.

EXSICCATI: Ellis, N. Am. Fungi 1317.

10. *Godronia Lonicerae* sp. nov.

Apothecia sessile or subsessile, attenuated below at first closed, externally dark colored, striated near the margin and clothed with poorly developed adpressed hairs, gradually expanding but with the margin constricted, .3 mm. diameter; hymenium dull but lighter than the outside of the apothecium; asci clavate, reaching a length of  $40-45\ \mu$  and a diameter of  $6-7\ \mu$ , 8-spored; spores slender rod-like  $1.5-2 \times 10-12\ \mu$ , containing several oil drops; paraphyses filiform,  $1.5-2\ \mu$  in diameter, slightly enlarged above, hyaline.

Apotheciis sessilibus vel subsessilibus, extus striatis, sordidis vel subatris, subtomentosis, primo clausis demum expansis, ore constricto, .3 mm. diam.; hymenio sordido; ascis clavatis,  $6-7 \times 40-45\ \mu$ , 8-sporis; sporis elongatis, guttulatis,  $1.5-2 \times 10-12\ \mu$ ; paraphysibus filiformibus, apice leniter incrassatis,  $1.5-2\ \mu$  diam.

On branches of *Lonicera canadensis*.

Type collected by R. F. Cain, June 17, 1931 at Lake Temagami, Toronto, Canada.

11. *Godronia fuliginosa* (Pers.) comb. nov.*Sphaeria fuliginosa* Pers. Obs. Myc. 2: 68. 1799.*Cenangium difforme* Fries; Moug. & Nest. Stirp. Crypt. 889. 1826.*Cenangium fuliginosum* Fries, Elench. Fung. 2: 23. 1828.*Tympanis difforme* Pers.; Tul. Fung. Carp. 3: 166. 1865.*Scleroderris fuliginosa* Karst. Myc. Fenn. 1: 216. 1871.*Lasiosphaeria striata* Ellis & Ev. Proc. Acad. Sci. Phila. 1893: 443. 1894.*Godronia Betheli* Seaver, Mycologia 3: 64. 1911.*Godronia striata* Seaver, Mycologia 4: 123. 1912.

Apothecia erumpent through the outer bark of the host, single or occurring in clusters, often so numerous as to form congested masses many cm. in extent and often almost entirely surrounding the branches on which they grow, the individual apothecia at first nearly globose, opening at the top so as to leave an irregular margin, at maturity about 1 mm. broad and the same in height, brownish and furfuraceous externally and longitudinally striated; hymenium whitish or bluish-white; asci clavate, reaching a length of  $130\ \mu$  and a diameter of  $7-8\ \mu$ , 8-spored; spores fasciculate in the ascus, subfiliform, tapering toward either end, sharp-pointed,  $3-4 \times 65-85\ \mu$ , becoming 7-septate at maturity and often slightly constricted at the septa, hyaline; paraphyses abundant, filiform.

Pycnidia often accompanying the apothecia, at first closed becoming shallow cup-shaped, usually black; pycnospores fusiform, straight or slightly curved, 3-septate,  $3-4 \times 28-30\ \mu$ .

On branches of *Salix*.

TYPE LOCALITY: Europe.

DISTRIBUTION: Ontario and Colorado; also in Europe.

ILLUSTRATIONS: Tul. Fung. Carp. 3: pl. 20, f. 1-4; E. & P. Nat. Pfl. 1<sup>1</sup>: 255, f. 187, H-J; Rab. Krypt.-Fl. 1<sup>3</sup>: 201, f. 3-7; Mycologia 25: pl. 15, upper figure.

This species was collected in abundance on willow at Tolland, Colorado, by the author in company with Ellsworth Bethel in 1910 and described as a new species, *Godronia Betheli*. Later study revealed the fact that *Lasiosphaeria striata* Ellis & Ev. is identical but owing to the fact that it had been placed in the Sphaeriales it had been overlooked. The young apothecia are strongly constricted which doubtless accounts for the fact that

Ellis placed it in that group. Recent study has revealed the fact that both Ellis and Everhart's species and the species of the writer are identical with *Cenangium fuliginosum* of Fries.

Specimens erroneously reported on *Alnus* by Kauffman (Papers Michigan Acad. 1: 109. 1923) have been examined and proved to be *Cyphella fasciculata* (see herbarium).

12. *Godronia seriata* (Fries) comb. nov.

*Cenangium seriatum* Fries, Sys. Myc. 2: 185. 1822.

*Phacidium seriatum* Fries, Elench. Fung. 2: 131. 1828.

*Triblidium seriatum* Fries, Sclerom. Suec. 161.

*Dermatea seriata* Tul. Fung. Carp. 3: 160. 1865.

*Gelatinosporium betulinum* Peck, Ann. Rep. N. Y. State Mus. 25: 84. 1873.

Apothecia occurring in elongated clumps 3-4 mm. long and about 2 mm. broad, closely compressed together and often slightly irregular from mutual pressure, entirely black, reaching a diameter of .5 mm.; hymenium slightly concave, bordered by a slightly upturned margin, black; asci clavate, reaching a length of 95-110  $\mu$  and a diameter of 10-12  $\mu$ , 8-spored; spores long, fusiform and usually slightly curved when free, reaching a length of 45-60  $\mu$  and a diameter of 2-3  $\mu$ , 3-septate; paraphyses slender, branched, hyaline or subhyaline.

The conidial stage accompanies the ascigerous and consists of a blackish stroma in which the pycnospores are produced; pycnospores fusiform strongly curved and 3-septate, reaching a length of 40-45  $\mu$  from tip to tip and a diameter of 2-3  $\mu$ .

On *Betula lutea* and *Betula fontanilis*.

TYPE LOCALITY: Europe.

DISTRIBUTION: New York to Pennsylvania and Colorado; also in Europe.

ILLUSTRATIONS: Mycologia 25: pl. 15, lower figure.

EXSICCATI: Ellis, N. Am. Fungi 537-537b; Fungi Columb. 853; Shear, N. Y. Fungi 200.

A fine collection of this species was obtained in Coal Creek Cañon, Colorado, by the writer and Paul F. Shope, in the summer of 1929 (No. 495), and determined by Mr. W. W. Diehl as *Scleroderris seriata* (Fries) Rehm. This is the only perfect speci-



men of this in the herbarium of The New York Botanical Garden from America.

Material which seems to be a part of the type collection of *Gelatinosporium betulinum* Peck is found in our collection. A note apparently in the handwriting of C. H. Peck reads as follows: "Perhaps the same as *Sphaeronema seriatum* B. & C. possibly a condition of *Cenangium seriatum* Fr." This conclusion is undoubtedly correct since our material collected in Colorado shows both stages on the same stroma. The pycnosporos agree very closely with those from Peck's type. No definite pycnidia could be detected.

13. **Godronia Kalmiae** (Rehm) comb. nov.

*Gorgoniceps Kalmiae* Rehm, Ann. Myc. 2: 353. 1904.

Apothecia gregarious, erumpent, at first cyathoid, short-stipitate, finally becoming irregularly discoid, externally reddish-brown, reaching a diameter of 1 mm.; hymenium at first concave, becoming plane or convex, sordid-yellow; stem very short and stout, gradually expanding into the apothecium; asci cylindric-clavate, reaching a length of 40–50  $\mu$  and a diameter of 5–8  $\mu$ , 8-spored; spores filiform, straight or curved when freed from the ascus, no septa apparent, 1  $\times$  25–30  $\mu$ ; paraphyses filiform, slightly enlarged above, 1–1.5  $\mu$  in diameter (FIG. 1, upper).

On decaying branches of *Vaccinium corymbosum*.

TYPE LOCALITY: North America (exact locality not given).

DISTRIBUTION: Known only from the type locality.

EXSICCATI: Ellis, N. Am. Fungi 147 (as *Dermatea Kalmiae* Peck). This material which was incorrectly named by Ellis was made the type of a new species by Rehm.

14. **GODRONIA NEMOPANTHIS** (Peck) Sacc. Syll. Fung. 8: 603. 1889.

*Tympanis Nemopanthis* Peck, Ann. Rep. N. Y. State Mus. 35: 142. 1884.

*Durandiella Nemopanthis* Groves, Mycologia 29: 75. 1937.

Apothecia occurring in cespitose clusters or occasionally single, sessile, slightly narrowed below, reaching a diameter of 1 mm. and a height of 1.5 mm., circular in form or becoming irregular from



mutual pressure, dull black, the consistency leathery to cartilaginous or horny when dry; hymenium at first concave, becoming plane or convex, black or olivaceous when moist; asci cylindric to clavate-cylindric, tapering below into a stem-like base, reaching a length of  $80-125\ \mu$  and a diameter of  $7-9\ \mu$ ; spores hyaline, filiform, septate, attenuated at the ends, straight or variously curved, intertwined in the ascus,  $1.5-2 \times 50-85\ \mu$ ; paraphyses hyaline, filiform, septate, branched,  $1.5-2$  in diameter, scarcely enlarged above, forming a yellowish hymenium.

On dead stems of *Nemopanthes canadensis* (*Nemopanthes mucronata*).

TYPE LOCALITY: Grafton, Rensselaer County, New York.

DISTRIBUTION: New York to Maine and Ontario.

ILLUSTRATIONS: Mycologia 29: 76, f. 3; 77, f. 4-9.

15. GODRONIA URCEOLUS (Alb. & Schw.) Karst. Acta Soc. Fauna Fl. Fenn. 2: 144. 1885.

*Peziza Urceolus* Alb. & Schw. Consp. Fung. 332. 1805.

*Peziza globularis* Pers. Myc. Eu. 1: 326. 1822.

*Cenangium Urceolus* Fries, Syst. Myc. 2: 182. 1822.

*Sphaeria uberiformis* Fries, Syst. Myc. 2: 491. 1823.

*Tympanis Urceolus* Wallr. Fl. Crypt. 2: 425. 1833.

*Mastomyces Friesii* Mont. Ann. Sci. Nat. III. 10: 135. 1848.

*Cenangium globulare* Fries, Summa Veg. Scand. 364. 1849.

*Crumenula Urceolus* De-Not. Comm. Critt. Ital. 1: 365. 1863.

? *Sphaeronema urceolata* Ellis, Bull. Torrey Club 6: 107. 1876.

*Godronia Cassandrae* Peck, Ann. Rep. N. Y. State Mus. 39: 50. 1886.

*Cenangium urceolatum* Ellis, Grevillea 6: 9. 1887.

*Cenangella urceolata* Sacc. Syll. Fung. 8: 591. 1889.

Apothecia scattered or rarely 5-7 closely crowded together, erumpent through the bark, usually with a short, thick stem, urceolate, reaching a diameter of .5-1.5 mm., externally brownish or brownish-black; hymenium grayish or pallid; stem very short and inconspicuous; asci clavate-cylindric, reaching a length of  $90-125\ \mu$  and a diameter of  $6-7\ \mu$ , 8-spored; spores filiform, many-septate,  $1.5 \times 50-75\ \mu$ ; paraphyses filiform,  $2\ \mu$  in diameter.

Reported on twigs of various kinds, *Alnus*, *Betula* and *Clethra*. Mastomian specimen on *Ribes* seems to agree.

TYPE LOCALITY: Europe.

DISTRIBUTION: Newfoundland to Michigan; also in Europe.

ILLUSTRATIONS: Alb. & Schw. Consp. Fung. *pl.* 3, f. 4; E. & P. Nat. Pfl. 1<sup>a</sup>: 234, f. 178-G-J; Rab. Krypt.-Fl. 1<sup>a</sup>: 217.

EXSICCATI: Ellis, N. Am. Fungi 990 (as *Cenangium urceolatum*).

Miss Daisy S. Hone in her Minnesota work (Minn. Bot. Studies 4: 111. 1909) describes a variety *Godronia urceolata conferta* which was said to differ in the habitat on *Prunus pumila* as well as in the clustered habit of the apothecia and the slightly shorter spores.

*Godronia Cassandrae* described by Peck from material collected on *Cassandra calyculata* appears to be identical with the above.

*Cenangium urceolatum* Ellis is identical. The spores are described by Ellis as fusoid, 1-septate and  $4 \times 15 \mu$ . These were apparently conidia or pycnosporos. Such spores have been found in connection with other specimens. The ascospores in this species are typical.

16. *Godronia montanensis* sp. nov.

Apothecia scattered, erumpent, superficial, at first urceolate, later expanding and becoming subdiscooid, blackish and minutely verrucose, reaching a diameter of 1 mm.; hymenium concave or nearly plane, pale yellowish; asci cylindric, reaching a length of  $175-185 \mu$  and a diameter of  $10-11 \mu$ , probably 8-spored; spores filiform nearly as long as the ascus, about  $3 \mu$  in diameter, many-septate and apparently breaking up into segments in the ascus, the segments about as long as broad; paraphyses filiform, about 1.5 in diameter.

Apotheciis sparsis, erumpentibus, demum subsuperficialis, primo urceolatis demum expansis, planis vel leniter concavis, extus subatris, leniter granulosis, 1 mm. diam.; hymenio concavo vel plano, flavo; ascis cylindraceutis,  $10-11 \times 175-185 \mu$ , 8-sporis; sporis filiformibus, circiter ascis longitudine,  $3 \mu$  diam., multiseptatis, disjunctis; paraphysibus filiformibus,  $1.5 \mu$  diam.

On sage brush.

TYPE LOCALITY: Sheridan, Montana.

DISTRIBUTION: Known only from the type locality.

This interesting species was found sparingly associated with *Dermatella montanensis* Ellis & Ev. and was probably overlooked by Ellis. The species differs from others examined in the spores becoming disjuncted in the ascus as well as in the size of the spores and asci.

17. *Godronia Cephalanthi* (Schw.) comb. nov.

*Peziza Cephalanthi* Schw. Schr. Nat. Gez. Leipzig 1: 123. 1822.

*Cenangium Cephalanthi* Fries, Syst. Myc. 2: 188. 1822.

*Scleroderma Cephalanthi* Farlow; Thaxter, Mycologia 14: 102. 1922.

Apothecia erumpent, usually in congested clusters several mm. long, the individual apothecia scutellate with the margin, dark brownish-black, reaching a diameter of 2 mm.; hymenium concave, pale yellowish; asci cylindric, reaching a length of 65–70  $\mu$  and a diameter of 10–12  $\mu$ , 8-spored; spores filiform about  $3 \times 65$ –70  $\mu$ , hyaline, becoming 5–7-septate; paraphyses filiform slender (FIG. 2, lower).

On *Cephalanthus occidentalis*.

TYPE LOCALITY: South Carolina.

DISTRIBUTION: New York and New Hampshire to South Carolina.

EXSICCATI: Reliq. Farlow. 103.

The description is drawn from material identified by C. H. Peck and W. G. Farlow. Specimens in the Schweinitz collection are immature and the spore characters therefore uncertain.

18. *Godronia viburnicola* sp. nov.

Apothecia erumpent in caespitose clusters of 2–10 each, the individual apothecia black, reaching a diameter of 1 mm., tapering below into a stem-like base; hymenium slightly concave or nearly plane, similar in color to the outside of the apothecium; asci cylindric-clavate, reaching a length of 110  $\mu$  and a diameter of 10–12  $\mu$ , 8-spored; spores filiform,  $3$ – $4 \times 85$ –100  $\mu$ ; paraphyses slender, branched, slightly enlarged above, and brownish.

Apotheciis erumpentibus, 2–10 caespitosis, atris, 1 mm. diam., turbinatis; hymenio leniter concavo vel subplano, atro; ascis cylindraceutis vel clavatis, 10–12  $\times$  110  $\mu$ ; 8-sporis; sporis filiformibus 3–4  $\times$  85–100  $\mu$ ; paraphysibus ramosa sursum incrassatis, pallide brunneis.

On *Viburnum cassinoides* and *Viburnum dentatum*.

TYPE LOCALITY: New Hampshire.

DISTRIBUTION: Known only from the type locality.

EXSICCATI: Reliq. Farlow. 154a, 154b.

19. **Godronia Fraxini** (Schw.) comb. nov.

*Peziza Fraxini* Schw. Schr. Nat. Ges. Leipzig 1: 123. 1822.

*Tympanis Fraxini* Fries, Syst. Myc. 2: 174. 1822.

?*Sphaeronema Fraxini* Peck, Ann. Rep. N. Y. State Mus. 29: 71. 1878.

?*Sphaerographium Fraxini* Sacc. Syll. Fung. 3: 598. 1884.

*Durandia Fraxini* Groves, Mycologia 29: 78. 1937.

Apothecia erumpent in clusters of 3-10 or rarely occurring singly, black or blackish, reaching a diameter of 1 mm., circular or irregular from mutual pressure; hymenium plane or nearly so, similar in color to the outside of the apothecium; asci clavate, reaching a length of 120-150  $\mu$  and a diameter of 10-12  $\mu$ , 8-spored; spores filiform, attenuated at either end, septate, 2.5-3  $\times$  50-90  $\mu$ ; accompanied by minute spore-like bodies; paraphyses filiform.

The apothecia often accompanied with *Sphaerographium Fraxini* which appears to be its conidial stage.

On branches of *Fraxinus americana*.

TYPE LOCALITY: North Carolina.

DISTRIBUTION: North Carolina to Massachusetts, Ontario and Ohio.

EXSICCATI: Barth. Fungi Columb. 3885; Rehm, Ascom. 2027; Reliq. Farlow. 155a-b.

20. **Godronia tabacina** (Cooke) comb. nov.

*Dermatea tabacina* Cooke, Bull. Buffalo Acad. Nat. Sci. 3: 24. 1877.

Apothecia erumpent, short-stipitate, usually in cespitose clusters or occurring singly, at first subglobose, becoming cup-shaped, externally bay-brown, slightly furfuraceous, reaching a diameter of .5 mm., when dry laterally compressed and decidedly hysteriiform; hymenium concave or nearly plane, paler than the outside of the apothecium, reddish-brown; asci clavate, reaching a length of

105  $\mu$  and a diameter of 18  $\mu$ , 8-spored; spores elongated, vermiform often attenuated at the ends, parallel with the ascus or twisted around, when free often indented like a rope about 6  $\times$  75  $\mu$ ; paraphyses thick clavate, reaching a diameter of 5  $\mu$ , brownish.

On branches of *Quercus*, especially *Quercus alba* and *Quercus coccinea*.

TYPE LOCALITY: New Jersey.

DISTRIBUTION: New Jersey.

EXSICCATI: Ellis, N. Am. Fungi 146; Rehm, Ascom. 359; Thümen, Myc. Univ. 1560.

21. *GODRONIA PARASITICA* Seaver, Mycologia 24: 354. 1932.

Apothecia scattered on the underside of the living leaf, especially along the midrib, erumpent, at first globose, becoming expanded but with the mouth constricted, black, reaching a diameter of .3-.5 mm.; hymenium dingy, more or less concealed; asci clavate, reaching a length of 250-300  $\mu$  and a diameter of 27  $\mu$ ; spores filiform, nearly as long as the ascus and about 4  $\mu$  thick, many-septate, the number of the septa difficult to determine but more than 50 have been counted, reaching a length of 25, paraphyses slender and rather freely branched.

On leaves of *Tetrazygia longicollis*.

TYPE LOCALITY: Marmelade, Republic of Haiti.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATIONS: Mycologia 24: pl. 9.

This is described from material collected by Mr. George V. Nash, August 25, 1903 (Nash 793). The species is distinguished by its huge asci and spores.

22. *Godronia Castanopsidis* sp. nov.

Apothecia thickly gregarious, erumpent through the bark, sessile, usually occurring singly; irregularly rounded, externally blackish, reaching a diameter of 2-3 mm.; hymenium plane with a dark elevated margin, pale yellowish or nearly white; asci subcylindric, tapering below into a stem-like base, attenuated above, reaching a length of 300  $\mu$  and a diameter of 16-18  $\mu$ , 8-spored; spores filiform, nearly as long as the ascus, hyaline, septate, 2  $\mu$  in diameter; paraphyses filiform, branched, pale yellowish, scarcely enlarged above, 2-3  $\mu$  in diameter.

Apotheciis gregariis, erumpentibus sessilibus, simplex; suborbicularis extus atris, 2-3 $\mu$  diam.; hymenio plano margine elevato, dilute flavo vel subalbo; ascis subcylindratis apice attenuatis, stipitatis, 16-18  $\times$  300  $\mu$ , 8-sporis; sporis filiformibus 250  $\mu$  long 2  $\mu$  diam.; hyalinis septatis; paraphysibus filiformibus, ramosis.

On dead branches of *Castanopsis chrysophylla*.

TYPE LOCALITY: Mount Shasta, California.

DISTRIBUTION: Known only from the type locality.

23. *GODRONIA PINICOLA* (Reb.) Karst. Acta Soc. Fauna Fl. Fenn. 2: 144. 1885.

*Peziza pinicola* Reb. Fl. Neom. 385. 1804.

*Peziza pinicola solitaria* Fries, Syst. Myc. 2: 113. 1822.

*Heterosphaeria pinicola* Fries, Summa Veg. Scand. 365. 1849.

*Crumenula pinicola* Karst. Myc. Fenn. 1: 210. 1871.

Apothecia erumpent-superficial, at first rounded, expanding and becoming shallow cup-shaped to scutellate black with a purplish tinge (purple by transmitted light) furfuraceous or slightly hairy, reaching a diameter of 2-3 mm., sessile or short stipitate; hymenium concave or nearly plane, similar in color to the outside of the apothecium; asci clavate, reaching a length of 120  $\mu$  and a diameter of 12  $\mu$ , 8-spored; spores in a fascicle near the end of the ascus or irregularly disposed, fusiform, hyaline, 3-4  $\times$  24-36  $\mu$ , becoming 1-3-septate; paraphyses slender, branched and forming a purplish epithecium (FIG. 3, upper).

On living branches of *Pinus rigida*, *P. pungens* and *P. resinosa*.

TYPE LOCALITY: Europe.

DISTRIBUTION: New Hampshire to Pennsylvania; also in Europe.

ILLUSTRATIONS: Not. Fauna Fl. Fenn. 10: pl. 2, f. e; Mycologia 18: 182, f. 1, B-C; Rab. Krypt.-Fl. 1<sup>a</sup>: 217, f. 1-5; E. & P. Nat. Pfl. 1<sup>a</sup>: 234, f. 178, A-C.

This was listed by L. O. Overholts as a *Crumenula* and possibly *Crumenula pinicola* (Reb.) Karst. in Mycologia 18: 181. It agrees reasonably well with the descriptions of that species except for the purplish color which was not mentioned by Karsten. It is, however, thought best to refer American specimens to that species.



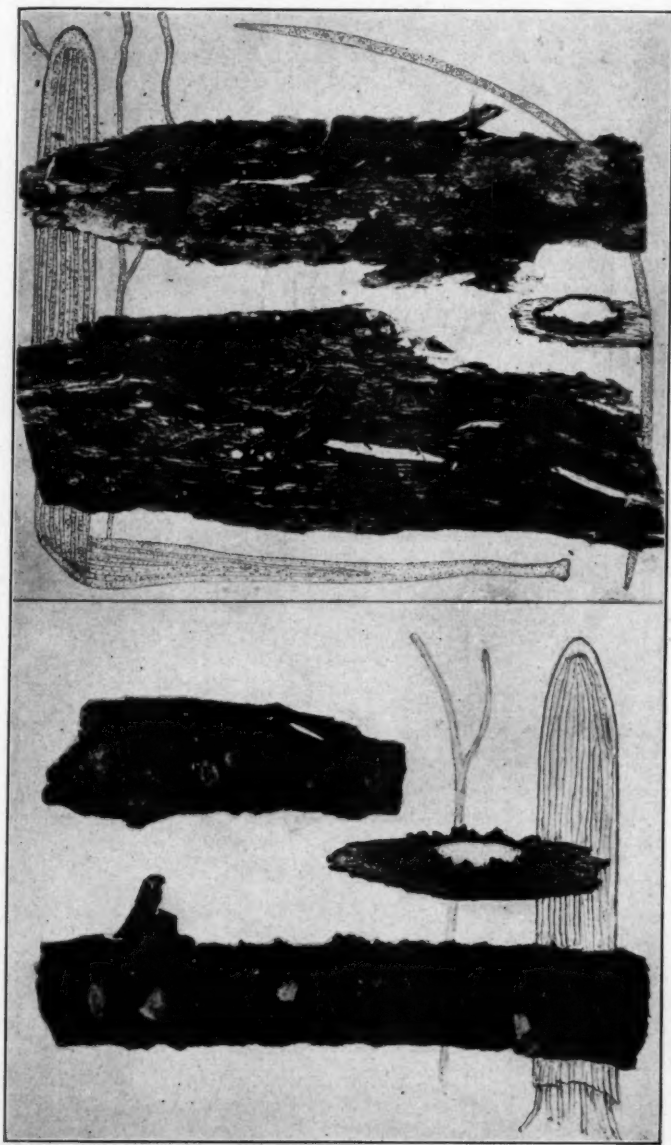


FIG. 2. Above, *Godronia jamaicensis*; below, *G. Cephalanthi*.

24. *Godronia Zelleri* nom. nov.*Atropellis pinicola* Zeller & Goodding, *Phytopathology* 20: 563.1930. Not *Godronia pinicola* (Reb.) Karst. 1882.

Apothecia solitary or gregarious, erumpent from outer cortical layers of bark, sessile or on very short central stalk, 2-4 mm. in diameter, at first closed, opening by stellate or irregular clefts, leaving rather fimbriate margins, expanding discoid, usually rolling up from two sides when drying, externally pruinose, black to fuscous-black; hymenium pruinose, black; asci clavate, hyaline, staining brown with iodine, 8-spored,  $74-178 \times 8-13 \mu$  (average  $100 \times 11 \mu$ ); spores filiform to acicular-clavate, hyaline continuous, guttulate,  $32-63 \times 1.5-3.5 \mu$  (average  $40 \times 2 \mu$ ); paraphyses hyaline, hair-like, flexuous, exceeding the length of the asci by  $32-38 \mu$ , tips slender, agglutinated, forming a dense epithecium with rosy and purplish tints in section.

Imperfect stage usually associated with *A. pinicola*:

*Fuckelia*: Stromata erumpent, sometimes scattered, mostly gregarious, black, pulvinulate, sessile to short-stipitate, 0.8-1.2 mm. in diameter, containing 16-35 locules (pycnidia); conidiophores from entire inner surface of pycnidia, hair-like, simple, and branched; conidia hyaline, continuous, narrowly ellipsoid to bacillar,  $8-11 \times 1.7-3 \mu$ .

On living branches and trunks of *Pinus monticola* and *P. contorta*.

TYPE LOCALITY: Oregon.

DISTRIBUTION: Oregon to Montana and British Columbia.

ILLUSTRATIONS: *Phytopathology* 20: pl. 1, f. G-M.

25. *GODRONIA SORORIA* Karst. *Acta Soc. Fauna Fl. Fenn.* 2: 145. 1885.*Crumenula sororia* Karst. *Myc. Fenn.* 1: 211. 1871.*? Cenangium piniphilum* Weir, *Phytopathology* 11: 295. 1921.

Apothecia erumpent in congested masses 1 cm. or more in diameter, the individual apothecia black or with a purplish tinge (decidedly purple when teased out), irregularly cup-shaped, closing when dry and often irregularly hysteriform, externally furfuraceous; reaching a diameter of 2-4 mm.; hymenium concave, similar in color to the outside of the apothecium; asci clavate, tapering very gradually into a long stem-like base, reaching a length of  $135 \mu$  and a diameter of  $12 \mu$ , 8-spored; spores irregularly 2-seriate above, fusoid, granular within, often slightly con-

stricted near the center and appearing pseudoseptate,  $5-6 \times 15-22 \mu$ ; paraphyses very slender, branched above and forming a purplish epithecium (FIG. 3, lower).

Forming cankers on trunks of *Pinus ponderosa*.

TYPE LOCALITY: Europe.

DISTRIBUTION: Idaho; also in Europe.

ILLUSTRATIONS: *Phytopathology* 11: 294, f. 1; 295, f. 2.

The only American material seen was collected in Idaho by J. R. Weir (15532) who writes: "Forming cankers on 16-year old pine, causing a black deposit to form." As pointed out by Karsten that species is similar to *G. pinicola* so far as apothecial characters are concerned. The specific name selected by Karsten doubtless indicates that it is a sister species to that one which was listed in the same paper. Both have the blue character with transmitted light which, however, was not mentioned by Karsten. Examination of authentic material of both species shows it to be present. The spores in this species are shorter and broader than in that one. It also has a black subiculum not noted in *G. pinicola*.

26. *Godronia Treleasei* (Sacc.) comb. nov.

*Scleroderris Treleasei* Sacc. Harriman Alaska Exp. 5: 24. 1904.

*Atropellis Treleasei* Zeller & Goodding, *Phytopathology* 20: 562. 1930.

Apothecia solitary, or gregarious, at first erumpent then entirely superficial, mostly sessile, at first pitcher-shaped, closed then scutellate, laciniately dehiscent, 2.5-4 mm. in diameter, expanding to 3-5 mm. when moistened; outside and margins torn, dusky purplish-gray (Ridgway), carbonaceous, rugose; hymenium flatly-concave to convexly expanded, waxy, "pinkish cinnamon to Sayal brown" (Ridgway); asci clavate with obtusely-acute apices, narrowly and long stipitate,  $100-178 \times 8-14 \mu$  (average  $100 \mu$  without stipe,  $167 \mu$  with stipe), 8-spored; spores fasciculate in upper part of ascus, mostly filiform, often somewhat clavate, hyaline, continuous,  $2-2.5 \times 42-60 \mu$ ; paraphyses filiform, with simple or incurved furcate tips which very slightly exceed tips of asci, hyaline.

On bark of *Picea sitchensis*.

TYPE LOCALITY: Alaska.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATIONS: Harriman Alaska Exp. 5: pl. 3, f. 7 a-g; Phytopathology 20: pl. 1, f. A-E.

27. *Godronia jamaicensis* sp. nov.

Apothecia scattered, erumpent through the outer bark, finally appearing quite superficial, sessile, becoming expanded and scutellate with a wavy margin, externally brownish-black and verrucose or wrinkled, reaching a diameter of 2 mm.; hymenium plane or slightly concave, surrounded by the upturned, blackish margin, pale yellowish or whitish; asci clavate, 8-spored, reaching a length of  $175\ \mu$  and a diameter of  $10\text{--}12\ \mu$ , 8-spored; spores filiform, nearly as long as the ascus,  $1.5\text{--}2\ \mu$  in diameter, no septa apparent; paraphyses filiform, freely branched (FIG. 2, upper).

Apothecii sparsis, erumpentibus, demum superficialis, sessilis demum planis, margine elevato, undulato, extus brunneo-atris, verrucosis vel corrugatis, 2 mm. diam.; hymenio plano vel leniter concavo, pallide flavo; ascis clavatis, 8-sporis,  $10\text{--}12 \times 175\ \mu$ ; sporis filiformibus circiter ascis longitudine,  $1.5\text{--}2$  mm. diam.; paraphysibus filiformibus, ramosis.

On bark of *Juniperus*.

TYPE LOCALITY: Cincohona, Jamaica, altitude 4500–5400 feet.

DISTRIBUTION: Known only from the type locality.

A liberal quantity of this material was collected by W. A. Murrill in 1908–1909, No. 495. The host species was not named but since only one species of *Juniperus* occurs in Jamaica it must have been that *Juniperus lucayana*.

28. *Godronia Abietis* (Naumov.) comb. nov.

*Fusisporium Bernice* Berk. & Curt. Grevillea 3: 147. 1875.

*Cenangium pithyum* Berk. & Curt. Grevillea 4: 4. 1875.

*Scleroderris pithya* Sacc. Syll. Fung. 8: 596. 1889.

*Bothrodiscus pinicola* Shear, Bull. Torrey Club 34: 312. 1907.

*Pycnocalyx Abietis* Naumov, Bull. Soc. Oural. Sci. Nat. Trud.

Bur Mykol. 35: 34. 1915.

*Ascocalyx Abietis* Naumov, Bolesni Rast. 14: 138. 1925.

Apothecia erumpent, usually in clusters of 3–6 arising from a rounded, black, basal stroma, circular or slightly wavy in outline, narrowed below, .3–1 mm. in diameter, dull black externally,



FIG. 3. Above, *Godronia pinicola*; below, *G. sororia*.

leathery to horny, becoming softer when moist; hymenium concave, becoming plane, smooth, gray to blackish, the margin infolded when dry; asci cylindric-clavate, short-stemmed, 8-spored,  $9-11 \times 65-100 \mu$ ; spores hyaline ellipsoid to subclavate, irregularly 2-seriate, simple becoming 1-3-septate,  $4-5 \times 14-22 \mu$ ; paraphyses hyaline, filiform, branched,  $1.5-2 \mu$  in diameter, scarcely enlarged above.

Pycnidia often arising from the stroma, at first almost globose, opening and becoming cup-shaped, reaching 2 mm. in diameter; pycnidial cavities immersed in the disc, ovoid, about  $25-75 \times 75-100 \mu$ ; conidiophores hyaline, tapering above,  $8-12 \times 1.5-2.5 \mu$ ; conidia hyaline, elongated to subfiliform, straight or curved, simple, becoming 1-5-septate,  $3-5 \times 16-24 \mu$ .

TYPE LOCALITY: Europe.

DISTRIBUTION: New Hampshire to Michigan and North Carolina; also in Europe.

ILLUSTRATIONS: Mycologia 28: 452, f. 1; 454, f. 2; 457, f. 3-6.

The above descriptions are based largely on Groves' records (Mycologia 28: 451-462. 1936.) As pointed out by him, *Cenangium pithyum* Berk. & Curt. was based on the conidial stage.

#### DOUBTFUL AND EXCLUDED SPECIES

*Godronia rugosa* Ellis & Ev. Jour. Myc. 8: 70. 1902. This species was described by Ellis from material collected at Tuskegee, Alabama, August, 1900 (G. W. Carver 479). The spores are described as fusoid, arcuate,  $45-55 \times 3-3.5 \mu$ . Examination of the Ellis material showed such spores but no trace of asci. It is probably not an ascomycete.

*Godronia Juniperi* Rostrup, Medd. Groenl. 3: 611. 1891. Apothecia scattered, sessile, hard, black reaching a diameter of 1-2 mm.; asci fusoid-clavate, reaching a length of  $75-85 \mu$  and a diameter of  $7-8 \mu$ ; spores filiform,  $2 \times 35-40 \mu$ ; paraphyses filiform. On wood of *Juniperus*. Known only from the type locality in Greenland.

*Godronia rhabdospora* (Berk. & Curt.) Sacc. Syll. Fung. 8: 602. 1889. *Tympanis rhabdospora* Berk. & Curt. Grevillea 4: 3. 1875. Spores said to be filiform. Reported on *Acer* from New England. No material seen.



## EXPLANATION OF FIGURES

FIG. 1. Upper, *Godronia Kalmiae*, photograph of two pieces of wood with apothecia enlarged about one-half, also enlarged drawing of several apothecia, an ascus with spores and three spores freed from the ascus. Lower, *Godronia Spiraeae*, photograph of three twigs with apothecia, slightly enlarged, also drawings of two apothecia much enlarged, ascus with spores and paraphysis, also three spores freed from the ascus.

FIG. 2. Upper, *Godronia jamaicensis*, photograph of two pieces of wood with apothecia, about natural size, with drawing of one apothecium much enlarged, also ascus with spores and paraphysis, and one spore freed from the ascus. Lower, *Godronia Cephalanthi*, photograph of two fragments of wood with apothecia, enlarged about one-half, also enlarged drawing of one apothecium and portion of ascus with spores.

FIG. 3. Upper, *Godronia pinicola*, photograph of a piece of branch with apothecia about natural size, also drawing of apothecia much enlarged, ascus with spores and paraphysis, portion of empty ascus, three loose spores, and hairs from outside of apothecium. Lower, *Godronia sororia*, photograph of wood with apothecia, about natural size, also ascus with spores and paraphysis, two loose spores, and hairs from outside of apothecium.

## SOME REMARKS ON MYCOGENETIC TERMINOLOGY

B. O. DODGE

The presidential address (Biological Section, Royal Society of Canada) "Life cycles and phylogeny in the fungi" by Professor H. S. Jackson (1944) will prove profitable reading, especially for botanists who are called upon to teach the more mature students in university courses. His work in the past has fitted him well to discuss the origin of the rusts and other Basidiomycetes. It is characteristic of him to assure us that his opinions are subject to revision in the event that new knowledge warrants a reconsideration. I have myself written many pages upholding the idea that in the fungi ascogonia and oogonia with their trichogynous outgrowths are female, and that antheridia, spermogonia and spermatia are male. Since these are morphological structures concerned with reproduction, we are justified in using them along with other features to mark the course taken by certain fungi in their evolution. The same can be said for pages in the support of the theory of the origin of the Ascomycetes and Uredinales from the Florideae. It is, therefore, gratifying to see how well we agree on the subjects he discusses. It may be well to point out, however, where we do not always quite agree with his statements or with the way he uses certain terms. I have, at one time or another, erred in the use of the same terms and upheld certain views which no longer seem tenable. I am, nevertheless, encouraged to make a few remarks relative to terminology in view of Professor Jackson's assurance that new knowledge always warrants a reconsideration.

### "SEXUALITY IN THE FUNGI"

Under the above heading Jackson says that sexuality in the fungi has, both in the past and in the present, often been misunderstood and misinterpreted. To this we all agree. We do not all quite agree, however, when he says, "Though the correct inter-

pretation has often been properly stated. . . ." It is an open question whether Blakeslee's implication that the  $+/-$  relation in the Mucoraceae is to be looked upon as a female/male relationship.<sup>1</sup> Differentiation of ascogonial and antheridial structures is certainly advantageous, or even essential, in some species, in bringing about sexual reproduction. Certain botanists would insist that without such morphological differentiations there can be no sexual reproduction. We are glad to see that our author does not support such a view. He frequently refers to the two nuclei that fuse in the teliospore, ascus and basidium as sex nuclei, or direct descendants of sex nuclei. This, seemingly without regard as to where they originally came from; that is, whether or not male or female structures are involved in the process. I used to deny that the Christman cell fusions in the rusts are sex fusions, and also that there is ever sexual reproduction in the mushrooms because no male or female structures are developed. I now take a broader view. The essential thing in sexual reproduction is the fusion of two nuclei. Compared to this how insignificant are those structures which, while often advantageous, are often dispensable. In *Neurospora*, for example, there are all sorts of ways and devices for insuring that two genetically different nuclei finally come together to fuse in the young ascus. Heterothallism in the form of  $+/-$  relations is, as Jackson holds, an efficient provision for hybridization. Or, as I once said (1936a), "The important thing for purposes of evolution would be that  $+/-$  races have a genetic

<sup>1</sup> This  $+/-$  versus female/male relation has been rather well analyzed and evaluated by Moewus in a number of papers. (See Moewus, 1933 and 1938, for references.) In 1933 he looked upon the formation of zygotes in *Chlamydomonas eugametos* as the result of a  $+/-$  relation between two gametes which are genotypically different but phenotypically alike. He postulated sex stuffs indicating that zygote formation here constitutes sexual reproduction. About 1938, after he had found that his  $+$  races copulated with the smaller gametes of *C. Braunii* and the  $-$  races with the larger gametes, he discarded the  $+/-$  symbols and substituted ♀ and ♂ symbols. Moewus' papers should not be overlooked in our discussion of sex in the fungi even though we may not always agree with his philosophy. It would not be surprising to find that comparable sex stuffs are formed by races of many fungi when they are operating in this  $+/-$  relation. In any event why continue to magnify out of all proportion phenotypic sex differentiations when  $+/-$  relations are so important.

differentiation. It is also important not to confuse  $+/-$  genetic differences in heterothallic species with phenotypic cell differentiation in case of hermaphroditic species." While I do not exactly like those symbols, no one seems to have improved on them as a means of avoiding positive commitments one way or another.

In a number of Ascomycetes this relation is governed by a simple pair of factors which some of us designate as  $A$  and  $a$  without any thought of dominance. Their effectiveness in breeding work is often badly interfered with by incompatibility or sterility factors. For example, certain heterocaryotic races of *N. tetrasperma* and *Gelasinospora* types (although both  $A$  and  $a$  factors are present in the component nuclei) are self-sterile or self-incompatible because of interfering factors. Separate out or isolate the individual component races,  $A$  and  $a$ , mate them against suitable tester races,  $a$  and  $A$  respectively, and fertile ascocarps are forthcoming. (See also Dodge, 1935, p. 435.)

Jackson gives us three illustrations of "proper interpretation" of sex in the fungi. (1) He says that, because of misinterpretation, papers are being published in which the authors use the expression "thalli of opposite sex." What a grand opportunity was by-passed at this point. This was a good place to give us not only the correct expression for "thalli of opposite sex" but also the correct interpretation of sex, sex nuclei, and sexuality in the fungi. Instead, he says of the expression "thalli of opposite sex," "... it is abundantly evident that the species they are dealing with is properly to be interpreted as bisexual (hermaphroditic) self-sterile and interfertile." One may wonder just how a *species* can be self-sterile.

(2) Discussing *Puccinia graminis*, he says, "The two haploid thalli developed from  $+$  and  $-$  basidiospores are not of 'different sex,' but are properly to be interpreted as bisexual (sexually homothallic), hermaphroditic, intersterile and cross fertile." This means nothing in the way it is worded, and neither "interpretation" clarifies the point raised.<sup>2</sup> What should these erring authors have

<sup>2</sup> Prof. Paul Weiss (1945), in a number of Science which has just come to hand, has something to say apropos of our use of terms. "The creation of new terms or symbols, even if only for temporary use to designate complex phenomena or situations, which otherwise would have to be circumscribed

said? I have suggested as substitutes "thalli of opposite sex-reaction," "thalli of opposite mating types," or just plain "two + and - thalli." These expressions mislead no one. Our breeding work proves that "two thalli of opposite sex-reaction" can be, in certain cases, self-sterile, intersterile or cross-incompatible.

(3) Turning to homothallism, our author says, "The term has also unfortunately been applied in connection with certain Ascomycetes (*Neurospora*, *Pleuraea*, *Gelasinospora*) which have four spores in an ascus. . . ." "Single nucleated isolates do not fruit. These forms are then basically heterothallic-hermaphroditic, self-sterile and interfertile." He omits here the first word "bisexual" with which he headed the interpretations in the two preceding illustrations. He characterizes *Gelasinospora* also as hermaphroditic when all its races are strictly "female" morphologically. No spermatia occur. Nevertheless (and this is what counts) normally the mycelium is heterocaryotic. Those who support the theory of relative sexuality could, of course, say that since all organisms, simple or complex, haploid or diploid, plant or animal, are potentially bisexual, *Gelasinospora* is potentially male even though it is actually only female. It is, therefore, bisexual (hermaphroditic). Such an argument would seem to be merely subterfuge.

Component races of *Gelasinospora* are of two sorts; these are races of opposite sex-reaction and they can be isolated very readily. Probably the two "female" races, the one + and the other - or of opposite mating type, will be found to synthesize sex stuffs, one kind female and the other kind male.

According to Blakeslee's original definition it was proper to characterize *N. tetrasperma* as homothallic, but when my cytological studies (1927, p. 294) proved that the small ascospores had only a single nucleus each at their origin, I looked upon races derived from them as "pseudoheterothallic." The expression

at each mention by long-winded phrases, should be encouraged." This reminds me of my own attitude when (1932) I said, "Is it necessary to explain again that I always use the terms 'sex' and 'opposite sex' simply for convenience until some one tells us just what it is that sets off the mechanism which regulates perithecium formation?" The same plea for the appropriate definition of sex or a term to be used instead of "opposite sex" has been repeated many times in print without response.

"facultatively heterothallic" was used in later papers (1935, 1936, 1936a) to characterize the four-spored species of *Neurospora*, *Gelasinospora* and *Pleurage*. I do not recall who originally proposed this expression. There is still a chance for a better term, one which distinguishes without a lot of explanation the four-spored types from the eight-spored types. To say that both are basically heterothallic misses the crucial differences when we are comparing *Neurospora tetrasperma* with *N. sitophila*. According to Jackson's own strictures (See his interpretation No. 2 above), *N. tetrasperma* would be doubly homothallic because he characterizes *Puccinia graminis* as sexually homothallic.

If one will study the cytological pictures (Dodge, 1942, fig. 1, 2) one must be convinced that there is something besides mere compatibility relations that draws two nuclei of opposite mating types together so beautifully at the 4-nucleate stage of the ascus. This "sex" reaction, or attraction, no doubt due to sex stuffs, has the effect of providing heterocaryotic ascospores. If sex hormones ever operate in the fungi they are operating here in the ascus and in a +/— relation, where the "survival value" of Lindegren (1933) is reversed. Survival here is insured by providing compatible, and not incompatible nuclei for the heterocaryon. Self-sterile heterocaryotic races of *N. tetrasperma* are more often of our own making through hybridizing mutant races. By proper manipulation one can obtain a rather complicated heterocaryon through nuclear migration. The resultant effect on vegetative growth characters may appear superficially to be one of dominance, even when the genes concerned are not allelic. If we are in the mood for change we can, of course, alter our concept of dominance to cover resultant effects of a conglomeration of genes in a built-up heterocaryotic haploid. The dominant-recessive relation even in the diploid ascus is not a very stable one, so we need not worry too much about dominance in haploids. The lethals *I* and *E* (Dodge, 1934, 1939) are truly dominant but only so when they actually cause ascus abortion in asci which are heterozygous *Ii* or *Ee*. It has often been cited, as an illustration of dominance, the situation which arises when one crosses 4-spored *N. tetrasperma* with 8-spored *N. sitophila* and finds that the  $F_1$  asci are 8-spored. Therefore, one could say 8-sporedness is dominant. But, as it



appears, 4-sporedness as contrasted with 8-sporedness must be regulated in this case by several pairs of factors working together. The resultant effect, then, may be only an apparent dominance. And so with dominance in haploid heterocaryons.

#### DICARYOTIC HAPLOIDS VERSUS DICARYOTIC DIPLOIDS

For many years past it has been a very common practice for botanists to refer to the ascogenous hyphae, and the dicaryophyte phase of rusts and mushrooms as diploid or sporophytic. There was good reason for calling the ascogenous hyphae diploid in those days when the theory of a double fertilization in Ascomycetes was so commonly accepted in America and England. For some of us it furnished an excuse for homologizing the outgrowths from the ascogonium with the ooblastema filaments of the red algae. Even after it was proved genetically that the nuclei of the ascogenous hyphae could not be diploid, we find authors still insisting that all such dicaryons in the fungi are *diploid*, even redefining the term to make it more nearly conform to their views.<sup>3</sup> We have discussed this practice at various times and more recently along with other items (1942; Dodge and Appel, 1944). It was brought out again that to call cells diploid, tetraploid, or polyploid accordingly as they have two, four or many haploid nuclei, is incorrect. To say that a dicaryotic or heterocaryotic mycelium is a hybrid structure is misleading. We could perhaps say prohybrid, protohybrid or pseudohybrid, but not *hybrid*. Man can separate or isolate the two haploid components of a dicaryon. The isolated component races are nothing more nor less than the ones which originally paired to form the dicaryon. Man cannot separate or isolate two genomes once they have been brought together in a fusion nucleus. It would be to defeat the great principles of evolution if, at meiosis, the identical genomes or identical combinations of genes were to come out intact after reduction, especially where the diploid fusion nucleus is extremely heterozygous.

*The mushroom fruit body.* Jackson (1944, p. 11) again takes me to task: "Dodge's statement (1939) that 'The larger part of

<sup>3</sup> Professor Weiss (see footnote 2) has something to say on this point also. "Use of the same term in different meanings by different authors is a common source of controversy, leads to polemics and should be eliminated."

the fruiting bodies of mushrooms and Ascomycetes are haploid, therefore, we should not use the term hybrid to describe a mere mingling of hyphae or nuclei of two different races to form the framework of such structures . . . indicates a fundamental misconception of the difference between the fruiting bodies of these two groups." "The mushroom," he says, "is totally the product of the dikaryotic diploid phase and with its supporting tissue is comparable to the dikaryotic diplont of the long-cycled rust." Now, we will all agree absolutely with this statement provided he will only substitute for the incorrect and misleading phrase "dikaryotic diploid," the correct and unimpeachable phrase "dikaryotic haploid." The dicaryophyte phases of the fungi are unique and highly important genetically. Why haul down our mycogenetic flag and try to warp the facts to make the dicaryon something that it is not? Our author realizes that everything is not crystal clear when he says, ". . . it is evident that the dikaryotic diplont of the rust and other Basidiomycetes may be compared with the  $F_1$  generation of other organisms having a true diplont." [*Italics mine.*] Now that heterocaryosis in the fungi is proving of such great significance we can say "heterocaryotic haploid" and "dicaryotic haploid" and in this way avoid all argument. For years, Prof. F. J. Ryan of Columbia University informs me, protozoologists have been familiar with certain species of *Protoopalina*, *Zelleriella* and *Giardia* that are normally provided with two nuclei, each nucleus being diploid. *Paramoecium aurelia* has two diploid nuclei in addition to the macronucleus. Have biologists called such organisms "tetraploids" or "dicaryotic tetraploids"? No. They look upon them as *binucleate diploids*. They could, if they wished, call them dicaryotic diploids and be correct.

Kerl (1937), in a paper which Jackson evidently overlooked, reports that she dissected out, and studied the growth, or regeneration, of antheridia, ascogonia, trichogynes and ascogenous hyphae of *Pyronema*. She has the answer for a statement made earlier (Dodge, 1932) as a probability, namely, that if one dissected out young antheridia, and if they were not too highly differentiated, they would produce mycelia with both antheridia and ascogonia. The same for ascogonia. Kerl was unable to obtain

regeneration of ascogenous hyphae, showing that the differentiation leading to ascus formation had gone too far so that reversion to a vegetative type of growth was no longer possible. Those who still hold to the theory of a double fertilization in *Pyronema* could say that Kerl's work proves that the nuclei of the ascogenous hyphae are actually diploid. Therefore, their cells could not regenerate. Dodge and Appel (1944), however, refer to a regeneration or vegetative growth of the ascus crozier of *Pezizella Lythri* observed many years ago.

Jackson's footnote No. 3 ends as follows. "In the interest of clarity students of the genetics of fungi might well adopt the system of symbols devised by C. E. Allen (1924, 1925) for use in the Bryophytes." This is an excellent suggestion and it is one I made many years ago (1928, p. 5). I erred at that time in including the ascogenous hyphae in the  $F_1$  generation and in referring to the  $f_1$  mycelia as hybrid mycelia. In mating *N. tetrasperma* + *N. sitophila* the ascogenous hyphae that are first developed still contain the parental nuclei  $p_1$  ( $A$ ) and  $p_1$  ( $a$ ) intact and still separate, though in the same cytoplasm. The  $F_1$  diploid generation is limited to the heterozygous ascus. The  $f_1$  haploid generation would include the ascospores formed in the  $F_1$  ascus, mycelia from these  $f_1$  ascospores, conidia, spermatia, or microconidia, incipient parithecia with their ascongonia and trichogynous outgrowths and, finally, the dicaryotic ascogenous hyphae. Since in this interspecific cross the  $F_1$  zygote is extremely heterozygous, the  $f_1$  races are all quite unlike either parent, but they are not thereby hybrid. They are haploid segregates.

As we interpret Professor Jackson's views set forth in his address, we all agree with him that the fusion of two nuclei in the smuts, mushrooms, Mucoraceae and yeasts, would also constitute a sexual reproduction. He could very easily have completed his fine set of diagrams by including diagrams of life cycles, one each, of the Exoascaceae, yeasts, smut fungi, and mushrooms, where sex organs, as we understand them in the fungi, do not exist. We would also have appreciated a diagram of the life cycle of *Gelasinospora tetrasperma*. These added diagrams would have made perfectly clear his conception of sex in these groups. One

wonders why he omitted the  $\pm$  symbols in the diagrams of the life cycle of *Sclerotinia Gladioli* after having used these symbols to designate the two kinds of thalli in *Puccinia graminis*.

As a closing statement regarding my present views on mycogenetic terminology, I can not do better than to quote from an earlier paper (1936). "If one is able to work out a terminology that will more exactly express the situation in these fungi, instead of adding to the confusion with glittering generalities we shall be grateful. In the meantime, if we must be inconsistent, let us be inconsistent where it will serve a useful purpose."

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## NOTES ON A PROPOSED NEW GENUS AND FOUR NEW SPECIES OF THE USTILAGINALES<sup>1</sup>

GEORGE L. ZUNDEL

### 1. A PROPOSED NEW GENUS

In 1893<sup>1</sup> Peck described a new species of smut collected by Dr. C. L. Shear on *Waldsteinia fragarioides* (Michx.) Trott. at Alcove, New York, to which he gave the name *Urocystis Waldsteiniae*. His original description is as follows: "Sori large, oblong, following the nerves of the leaf, commonly near the margin and nearly parallel to each other, surrounded by the ruptured epidermis, black; spores not easily separable, three to six or more in a glomerule, the central and peripheral similar, subglobose or elliptical, often angular, .005 to .006 inch long, .0004 to .0005 broad, the glomerules very unequal in size and in the number of component spores. On living leaves of barren strawberry, *Waldsteinia fragarioides*."

In 1900<sup>2</sup> Ellis and Everhart described a new smut species collected by Robert M. Horner (No. 1430) at Waitsburg, Walla Walla Co., Washington, on *Geum ciliatum* Pursh., to which they gave the name of *Urocystis Gei* Ellis & Ev. with the following description: "Sori epiphyllous, bullate, elongated, .5-1 cm., opening along the middle as in *U. Anemones*, forming by the inflated epidermis; central spores polar, subglobose, 12-16  $\mu$  diam.; peripheral spores darker, slightly granular-roughened, globose, 10  $\mu$  diameter, or ovate, 10  $\times$  6-7  $\mu$ ."

It must be noted at this point that Clinton<sup>3</sup> considered the above mentioned two new species as one and the same, using the name *Urocystis Waldsteiniae* Peck. In 1895 Otto Pazschke issued this

<sup>1</sup> Ann. Rep. State Botanist of the State of New York, 1893: 32. 1893. (From 46th Rep. of the N. Y. State Museum of New York.)

<sup>2</sup> Bull. Torrey Club 27: 571-578. 1900.

<sup>3</sup> Proc. Boston Soc. Nat. Sci. 31: 447, 448. 1904.



smut in Rab.-Wint.-Paz. Fungi Eur. 4011 under the name of *Ustilago Waldsteiniae* Paz.

Clinton in 1904<sup>3</sup> and in 1906<sup>4</sup> includes this smut in the genus *Urocystis* with the following note: "The generic position of this species is unsettled, but it is placed here until further study determines its place." Clinton<sup>3</sup> had previously reported in his Harvard thesis that Thom had determined that this species germinated as a *Ustilago*. Hansen and Atkinson<sup>5</sup> confirmed the findings of Thom in 1938.

Clinton<sup>3</sup> in 1904 wrote concerning this species as follows: "This fungus is peculiar in that while it has the general aspect of an *Urocystis* its position under this genus is somewhat doubtful since it lacks the peripheral layer of sterile cells. Neither does it seem to be a true *Ustilago*, as considered by Paszschke, since the spores adhere in pairs or small groups. The species needs further study, especially of the formation and germination of its spores, to determine its true generic position. The spores that adhere in pairs have the appearance of *Schizonella*. Often some of the largest spores appear to be sterile cells merely. The species described by Ellis and Everhart on *Geum* is not distinct."

From a study of the literature and of available specimens the writer has decided that this smut belongs to an undescribed genus of the family Ustilaginaceae Schröt., and proposes the following name in honor of his former teacher at Cornell University, Herbert Hice Whetzel, with the following description:

**Whetzelia** Zundel, gen. nov.

Sori in the leaves, following and infecting the veins, swollen, covered by an indusium of epidermal tissue which on maturity splits longitudinally dividing the sorus in two nearly equal parts and exposing a conglutinated spore-mass; spores produced singly or in indefinite spore-balls in pairs, triplets or sometimes quinate, rarely more; single sterile cells rare but sometimes attached to the spore-balls, lighter color than the fertile spores; germination as in *Ustilago*.

Soris in foliis venas inficientibus, tumefactis et indusio epidermidis tectis, soris indusio maturo rupto fere dimidiatis et massam sporarum conglutinatam

<sup>3</sup> N. Am. Flora 7: 55. 1906.

<sup>5</sup> Phytopath. 28: 8. 1938.

detegentibus; sporis singulis vel globis variis, binis, trinis, aliquando quinis, raro pluribus; cellis singulis sterilibus raris, aliquando massae sporarum adjunctis, colore clarioribus quam sporis fertilibus; germinantibus ut apud *Ustilaginem*.

One species, *Whetzelia Waldsteiniae* (Peck) Zundel.

Recently smut specimens received from Colombia, Guatemala and Hungary have been studied and appear to be new species as follows:

1. *Ustilago concelata* Zundel, sp. nov.

Sori destroying the inflorescence,  $2\frac{1}{2}$  to 3 mm. long, concealed by the leaf sheath, spore-mass dark reddish-brown surrounding the rachis as a powdery mass; spores globose to subglobose, regular, light reddish-brown, smooth, thin epispor.

Soris inflorescentiam perdentibus, 2.5–3 mm. longis et vagina folii celatis, massa pulverulenta sporarum fusce rubro-brunnea rachidem cingente; sporis globosis vel subglobosis, regularibus, dilute rubro-brunneis, levibus, episporo tenui.

On *Ischaemum latifolium* (Spreng.) Knuth. Coll. C. Garces O, "La Normal," Medellin, Colombia.

2. *Ustilago Garcesi* Zundel, sp. nov.

Sori as short striae on the leaves which finally cause a shredding of the foliage; spores globose to irregular or angled, reddish brown, 8.5 to 10.5  $\mu$  diameter, smooth and granular under immersion lens.

Soris in foliis breviter in strias dispositis, foliis ipsis denique minutatum scissis; sporis globosis vel irregularibus vel angulatis, rubro-brunneis, 8.5–10.5  $\mu$  diam., levibus et granularibus immersione ut dicunt olei visis.

On *Paspalum saccharoides* Nees, Palmira (Valle, Estacion Experimental), Colombia. Coll. C. Garces O, Dec. 13, 1940—Fungi of Colombia 1281.

3. *Urocystis Unger* Zundel, sp. nov.

Sori as elongated striae in the leaves, somewhat pustular, grayish, covered by a membrane of host tissue; spore-balls globoid, chiefly irregular, consisting chiefly of one fertile spore, rarely two, completely surrounded by light reddish-brown sterile cells, chiefly 17.5 to 24  $\mu$  in diameter; spores globose to subglobose, dark reddish-brown, chiefly 12.7 to 18  $\mu$  diameter, smooth.

Soris elongatis striatisque in foliis, sub-pustularibus, canescentibus, membrana hospitis tectis; massa sporarum globoidea, plerumque irregulari, singulis praecipue fertilibus sporis, vel rariter binis, cellis sub-rubro-brunneis circumdatis,  $17.5\text{--}24\ \mu$  plerumque diam.; sporis globosis vel subglobosis, fusce rubro-brunneis,  $12.7\text{--}18\ \mu$  diam., levibus.

Hab. in *Polygonato multifloro* (L.) All., "Doubrava," Moravia, Coll. Bubak, 14 Mai. 1898; Budapest, Coll. Dr. G. von Moesz, 1 Jun. 1929.

Descriptio nostra facta est de duobus speciminibus, quae ex Moravia Hungariaeque recepta titulos tulerunt *Tuburcinia paridis* (Unger) Vestergren. Investigata autem male determinata videntur, quapropter nova species hic proponitur atque describitur.

On *Polygonatum multiflorum* (L.) All., "Doubrava," Moravia, Coll. Bubak, 14.V.1898; Budapest, Coll. Dr. G. von Moesz, 1.VI. 1929.

The above description is based on two specimens received from Moravia and Hungary both labeled *Tuburcinia paridis* (Unger) Vestergren. Upon examination it was revealed that the determinations were apparently in error and therefore a new species is tentatively proposed and described.

#### 4. *Entyloma Tagetesium* Zundel, sp. nov.

Sori in the foliage, distinct, pustulate and globoid, light colored,  $\frac{1}{2}$  to 1 cm. diameter; spores packed in host tissue, globoid or angular by compression, tinted reddish-brown to hyaline,  $10.5$  to  $14\ \mu$  diameter, epispore  $0.5$  to  $.75\ \mu$  thick.

Soris in foliis, distinctis, pustulatis globosis, colore diluto,  $0.5\text{--}1$  cm. diam.; sporis dense in hospite compactis, globosis vel compressione angulatis, rubro-brunneis vel hyalinis,  $10.5\text{--}14\ \mu$  diam., epispore  $0.5\text{--}0.75\ \mu$  crasso.

On *Tagetes* sp., Chimaltenango, Guatemala. Coll. Albert S. Müller (No. 188), Aug. 28, 1942.

#### ACKNOWLEDGMENT

The willing coöperation of Dr. Robert E. Dengler, Professor of Classical Languages, The Pennsylvania State College, who wrote the Latin descriptions, is hereby gratefully acknowledged. Any errors are to be charged to the oversight of the author.

CONTRIBUTION FROM THE DEPARTMENT OF BOTANY,  
THE PENNSYLVANIA STATE COLLEGE NO.

## NOTES ON BOLETES. VII

WALTER H. SNELL

(WITH 1 FIGURE)

Most of what follows was first put in manuscript form two or three years ago and has lain all but forgotten because of the distractions, new duties and changes in one's life brought about by the war. A brief respite during the summer months, however, has provided opportunity to prepare these notes for publication.

### CORRECTIONS AND CHANGES

In *Mycologia* 33: 422. 1941, the species *californicus* Murr. was placed in *Gyrodon* as a new combination. This change was an unfortunate error, for study of the type-material shows that Murrill had it correctly placed in the genus *Rostkovites* of his system or the more recently proposed *Suillus* (= *Ixocomus* Quélet = the *Viscipelles* of *Boletus* of Fries and Peck—see *Mycologia* 34: 406. 1942). Not only do the spores place this species in the old *Viscipelles* of *Boletus* (or the genus *Suillus*) but also the glandular-dotted tube-walls and mouths, and stipe. The surface of the pileus is very fibrillose-tomentose to more or less fibrillose-scaly and is probably more or less viscid under moist conditions.

All these characters immediately remind one, however, of the species *hirtellus* Peck (= *tomentosus* Kauff.) and especially its more fibrillose-patchy to fibrillose-scaly variety *mutans* Peck. The only differences are the much more tomentose or fibrillose condition of the surface of Murrill's species and the spores slightly larger ( $8-11.5 \times 3-4.5 \mu$  as against  $7-11 \times 2.5-3.5 \mu$ ) and slightly deeper olivaceous. While heretofore no collection of *hirtellus* or its variety *mutans* has been seen with these extremes of surface clothing and of spore size and color, nevertheless it appears that *californicus* belongs in the *hirtellus* complex. Therefore, until more collections than the type are available for determining

whether Murrill's collection is only an extreme variation of *hirtellus* or definitely distinct, *californicus* will be considered as a form of *hirtellus*.

In Mycologia 33: 26. 1941, a roseate *Boletinus* from Washington was named *forma rubrotinctus* of *B. cavipes*. Further study seems to show that this is *B. ochraceoroseus* Snell.

#### FOUR SPECIES OF SUILLUS

In the genus *Suillus* there are some groups of species which have probably proved perplexing to every collector of the Boleti. Two of these groups have the species centering around two of the longest recognized species—*S. luteus* (L. ex Fr.) S. F. Gray and *S. granulatus* (L. ex Fr.) Kuntze (or what has commonly been accepted as this species in America from the very beginning of mycological collecting). Peck thought he understood the species in question, but subsequent workers have had their doubts about specific validity. While I myself agree with Peck with confidence, on the other hand every so often in wakeful hours in the dead of night I have wondered if some species so sharply distinguished in written descriptions might not really be variational responses to differing conditions of climate, soil, water and rain, mycorrhizal host, and so on. Accordingly, it was very reassuring recently to find almost perfect conditions for confirming one's convictions with regard to some of these species.

The fall of 1942 was not particularly rainy in southeastern New England, but in the first half of October certain localities were replete with fleshy fungi. For example, at Centerville on sandy Cape Cod (part of the Commonwealth of Massachusetts, for the benefit of those unacquainted with New England's "stern and rock-bound coast"), many practically pure stands of pitch pine contained thousands of fruit-bodies. On October 4th, 95 per cent of these were *Leccinum versipelle* (Fr. *apud* Hök) Snell [or *L. aurantiacum* (Bull. ex Rocques) S. F. Gray, as it may turn out to be]. On October 18th, fully half of these were this same species, but at least four *Suilli* made up most of the remaining half, with a sprinkling of agarics, clavarias and puffballs. These four species grew clumped in colonies over large areas in places,

and elsewhere pretty well mixed. In one spot, one specimen of each of three species grew in a triangle about 15-18 inches on a side.

The species were two pairs—*S. luteus* and *S. subluteus* (Peck) Snell, and *S. granulatus* and *S. brevipes* (Peck) Kuntze. As

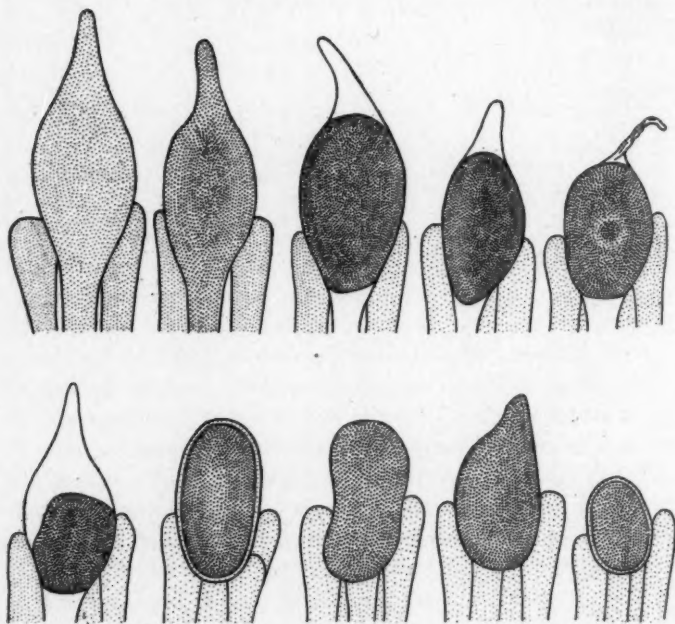


FIG. 1. Arrangement of drawings in putative sequence showing the formation of brown bodies in the hymenium of certain *Boleti* by the possible degeneration of cystidia,  $\times 1000$ .

seen from above, the pilei of all four species looked about the same even to a practiced eye. About the only differences that were superficially obvious were that *S. luteus* was a little thicker and more rounded-pulvinate and that the gluten of *S. brevipes* was more copious and tougher, often giving a grayish or lurid or sallow color.

Closer examination of the first species confirmed the differences which have appeared to be sufficiently constant. I have always



found the pileus of *S. luteus* rounded-pulvinate to something approaching umbonate and therefore with flesh comparatively thick, while *S. subluteus* is at best plano-convex and usually more or less applanate, with margin often repand, and with correspondingly thinner flesh as described. The tubes of the former species were darker and more orange and smaller and more reddish-glandular-dotted, those of the latter more pale yellow, a little larger and much less glandular-dotted. Also as described, the veils and annuli differed. The veil of *S. luteus*, even when retracted so that it did not entirely sheath the stem, was much more extensive on the stem and formed a prominently flaring annulus, while the veil of *subluteus*, even though in some of these specimens more extensive on the stem than I have observed before, was collapsed to form a decidedly glutinous band which was flaring only occasionally and to a slight extent. The color differences also were distinctive except in an occasional specimen. More especially, many of the stipes of *luteus* were very orange-buff, the flesh of the pileus and stipe was the same and at the base of the stipe more orange to light or deep Indian-red.

Similarly, *S. granulatus* and *S. brevipes* could be easily distinguished on the basis of the commonly described characters, even though in this case the color of the pileus of *brevipes* was about the same as that of *granulatus* except for the usual difference imparted by the thick tough gluten. The stipe of *brevipes* was of course short and stocky, was inclined to have less yellow and especially less inclined to have the yellowish apex of *granulatus*, had fewer and more inconspicuous glandular dots, and also was decidedly reticulate in a narrow zone at the very apex from the descending walls of the tubes, or undulately wrinkled in a conspicuous manner as contrasted with *granulatus*. The spores of *S. brevipes*, as described, in these specimens, were mostly over  $8\mu$  long instead of mostly  $7\mu$  or under for *granulatus*.

Hence, the conclusions arrived at from different studies of scattered collections at different times were beautifully substantiated by the unusual co-existence of these four species in a single habitat. It was particularly gratifying to find *granulatus* and *brevipes* in the same place at the same time. I have found *granulatus* occasionally very late in the fall but I have never found

*brevipes* at other times than from the very last of September until November 1st, as Peck originally stated in general as "very late in the season." I had often wondered if *brevipes* might not be only a form of *granulatus* stimulated by lower fall temperatures, perhaps by frost.

As a footnote to the foregoing, one other observation might be added. Peck described *Boletus albidipes* [which would now be *S. albidipes* (Peck) Snell, comb. nov.] as having a paler pileus, with conspicuously appendiculate margin, white flesh, stipe white without yellow and not dotted, and larger spores. I once found a young stage which appeared as if it might be this species, especially because of its copious, cottony, marginal tissue, but on the other hand I have also seen mature *granulatus* with something of this character. At Centerville on October 18th, 1942, I found several specimens among the other four species discussed above which had the *albidipes* characters in varying degree. It perhaps is not proper as yet to decide to give up the hope that a good *albidipes* will be found at some time, but on the other hand the recent specimens indicate that such forms are only extreme variations of the old species.

#### SOME OF THE LURIDI

It is going to take quite a bit of working over to solve all the problems of this group and therefore only a few remarks are made here.

*Boletus magnisporus* Frost apparently is a very rare species. It should be readily recognizable, with its golden-yellow pileus and red and yellow stipe, but few have reported it. I have never collected it. The spores of Frost's specimens at Burlington, Vermont, were as described— $10-22 \times 4.5-9 \mu$ , mostly  $14-16 \times 5-5.5 \mu$ —but I found the spores of the supposed type or co-type at the Farlow Herbarium to be  $9-12 \times 3-3.5 \mu$ —hardly "large-spored."

*Boletus firmus* Frost is another species which has not been studied carefully because of its rarity. Krieger was certain he had it from Canada (The Mushroom Handbook, 1936, p. 265). I have found the following variations in spore measurements: the

type in the Frost Herbarium at Burlington, Vermont— $9-12 \times 4-5 \mu$ ; supposed type or co-type at the Farlow Herbarium— $9-12 \times 2.5-4 \mu$ ; specimens so labelled at Albany, N. Y.— $11-15 \times 4-5.5 \mu$ .

There has been a great deal of misunderstanding in this country concerning the common member of the *Luridi* with the conspicuously furfuraceous stipe. Many collectors and workers have failed to distinguish between the species with reticulate stipe and the one with the furfuraceous stipe, and have called everything of either sort *B. luridus* Schaeff. ex Fr. Others have called specimens with furfuraceous stipe var. *erythropus* of *B. luridus*. A few have considered the mealy-stiped entity a distinct species, the same as the European *B. erythropus* Fr.

Very few have reported finding Peck's *B. subvelutipes*, a species characterized as having the stipe "*velvety with a hairy tomentum toward the base*" (Peck, Boleti of the United States, 1889, p. 142)—partly perhaps because they expected to find specimens with a lot of conspicuous tomentum on the stipe. I myself was misled at first by this erroneous conception, and especially later after I saw in Peck's folders at Albany a water-color drawing of specimens with stipe having a yellow apex, the remainder pale reddish-purplish with red mealiness, and a copious and conspicuous mass of brown velvetiness or tomentum extending about an inch up from the dirt at the base. I got in the habit of looking for specimens with these striking characters and never found them. Many perhaps followed Murrill (North American Flora 9: 151. 1910) in considering *subvelutipes* as the same as *luridus* (including *erythropus*, or what had passed for it, if it was considered at all).

When one began to look at his collections of the common species with red tube-mouths and furfuraceous stipe at all carefully, however, it was found that they all had a greater or lesser amount of a coarse velvetiness or tomentum or strigosity at the base of the stipe, perhaps more or less underground or in the debris at the base, not brown in color but a rich buff-yellow or deep red. Sometimes there was only a very small patch of this velvetiness and rarely it was reasonably extensive and conspicuous, but it was always there. One began to suspect that he was dealing all the time with *subvelutipes* and not with the European *erythropus*

at all. A study of Peck's specimens at Albany, some labelled *subvelutipes* and some *erythropus*, disclosed the same velviness at the base of the stipe in all of them, only a small patch in some cases and in one specimen, as I recall, with this clothing extending for a distance of two inches.

Accordingly, nearly ten years ago, I came to the conclusion that our common member of the *Luridi* with furfuraceous stipe was Peck's *subvelutipes* and not the European *erythropus* in any sense, and I have been accustomed so to identify specimens sent by numerous collectors over the country.

The question naturally arises then—do we have in this country anything comparable to the European *erythropus*? I can add only the following remarks. Under some hemlocks near Bridgewater, Vermont, in 1932, I collected some fairly large specimens badly infested with eelworms (see *Mycologia* 26: 358–359. 1934), which I determined with some puzzlement as *B. erythropus* but which were entirely different from what had been commonly known by this name (now *subvelutipes*). They were much more yellow on the pileus and stipe, with only a little red on either and no rich brown on top, and the tube-mouths were only partially reddened. As I have thought of them since and compared them with European descriptions and colored illustrations, they look a great deal like *erythropus*, but I would hesitate to declare that they are. Further, I have had some correspondence and exchange of water-color drawings with Paul Marshall Rea of Santa Barbara, California, as a result of an original, tentative identification of certain specimens as Peck's *subvelutipes*. Some of Rea's specimens are small and relatively slender like the smaller sort of specimens of *subvelutipes* in the east, while others are very stocky and thick, with very ventricose stipe. All I can say at the present moment is that I do not know what species of this group they have in California, but that it is possible that *erythropus* occurs out there.

#### NOTES FROM FROST'S HERBARIUM

Frost, the "Shoemaker Botanist of Brattleboro, Vermont," must have worked under rather difficult conditions—without much literature, without herbaria for purposes of comparison, apparently

without much except some sort of contact with Charles H. Peck. Nevertheless, he effected some very solid accomplishments with the Boleti. He apparently had a very good eye for new species and he originally described many more than are now recorded to his credit for the reason that he found that Peck had anticipated him in a goodly number. Frost left behind him, exclusive of specimens now in the Farlow Herbarium or in Peck's Herbarium at Albany, a fair-sized herbarium of fungi, which is now preserved at the University of Vermont. This herbarium is in much better condition than was expected from reports—much better than could be expected when one learns that for many years before it was obtained by the University of Vermont, it was stored in an attic, unprotected against extreme changes of temperature, insects, mice, occasional leaks in the roof and so on.

On a visit to the Frost collections in the summer of 1941, the present writer was delighted to find so much in such good condition. Doubtful and abandoned species were there as well as the types of common and well-understood ones. All were examined more or less completely, but some unfortunately not completely enough to answer the innumerable questions which have come to mind in the succeeding months. Some of the fruits of this pilgrimage are given below.

It was suggested (Mycologia 33: 26. 1941) that Frost's description of *B. ferrugineus* would fit *B. pseudodecorus* Snell and Dick. Comparison of specimens of the latter with Frost's types confirm the suspicion that they are the same. Contrary to what was said erroneously in the above-mentioned article, Frost's name is valid under the International Rules and *pseudodecorus* drops into synonymy.

*B. sordidus* has not been at all understood since it was named by Frost from Vermont. Peck records it as collected elsewhere only by Morgan in Ohio. As far as the writer knows, no one else has collected it with certainty. Its description reads much like two species at least for the present placed in the genus *Porphyrellus*—*P. porphyrosporus* (Fr.) Gilbert and *P. fumosipes* (Peck) Snell, comb. nov. The main differences in the descriptions are that the spores of *sordidus* are given as yellowish-brown to dirty brown in deposit, while the other two species have spores purplish-drab or

porphyry-reddish to purplish-brown in deposit, and that *fumosipes* has a rimose-areolate surface while that of *sordidus* is even. I along with others have often wondered if *fumosipes* and *sordidus* are not the same, and Coker and Beers (The Boletaceae of North Carolina, 1943, pp. 71, 72) have decided that they are and call the single species *sordidus*. This may be the proper disposition of the difficulties but I still want to convince myself by finding the answers to a few questions. The difference in the surface of the pileus has run true to form in my somewhat limited experience with the complex, as has also a difference in spores.

A few years ago, the writer found a single specimen labelled *sordidus* in Peck's herbarium at Albany, but since then it has been rather elusive and the writer had begun to lose confidence in the specimen and in his observations of its spores. Study of Frost's types at Burlington in 1941, however, resulted in some very clear convictions. The original description reads a little more like that of *fumosipes* but the dried specimens look more like *porphyrosporus* than *fumosipes*. The spores, however, appear to be quite distinctive. They are shorter than those of *porphyrosporus*, the majority are even a little shorter than the majority of *fumosipes*, and they are as broad as those of *porphyrosporus*. They are less inclined to be subfusiform than those of the other two species, and more amygdaliform than elliptical or subelliptical, and they are a deep, dull brownish-yellow in color, with homogeneous contents, instead of with reddish outer contents and a greenish center as in the other two species as I have understood them. The spores are therefore quite distinctive—in form from any other species of Boleti and in deposit from the two species which they seem outwardly more or less to resemble.

Even though the genus *Porphyrellus* remains to be more precisely defined, the facies of the species *sordidus* and its spores definitely suggest a close relationship with the other two species of the genus and accordingly, it will be so placed at least for the present, as *P. sordidus* (Frost) Snell, comb. nov.

*Boletus limatulus* was for a long time as much of a puzzle as several other species of Frost's, until some of its odd characters brought to mind some unusual specimens collected by the writer at McCollums, N. Y., a few years ago. These specimens were



first seen under a white pine when very small and because of their peculiarities and dissimilarities from the well-known species under white pine they were followed in their development until maturity, even at the inconvenience of several long trips by car just for this purpose. These were finally determined, with a slight tinge of irritation at the time, energy and gasoline spent, as merely a variant form of *Xerocomus badius*. They were characterized by yellow-brown color instead of bay, by the tube-mouths here and there thickened and colored yellowish-brown to reddish-brown, by cystidioid structures, and by spores often a little larger, especially a little broader. In his characterization of *B. limatulus*, Peck described the pileus as "*viscid when moist, somewhat polished and shining when dry, rich yellowish brown, flesh reddish in the pileus . . . ; tubes . . . greenish yellow, their mouths yellowish brown . . .*," and below remarked that although the differently colored tube-mouths made the species approach the *Luridi*, it would be placed in the *Edules* because the mouths were not red or reddish. It appears that Frost's species should be considered as a variety of the Friesian—*Xerocomus badius* (Fr.) Gilbert var. *limatulus* (Frost) Snell, comb. nov.

*Boletus tenuiculus* is a very slender-stemmed species described as having both pileus and stipe "lurid-red on a yellow ground." While there is no unanimity as to the precise meaning of "lurid," it appears that the older workers used the word in the sense of pale or sallow or dingy or sordid. Of a few more or less well-known species of which *tenuiculus* might be a long-stemmed form, the color description perhaps best applies to Peck's *B. fulvus*. This species sometimes has a stipe which is quite long and rather slender, although the pileus is not "thin" as given in the original description of *tenuiculus*, but neither are the pilei of some of Frost's specimens. On the basis of information available at present, however, it does not appear desirable to suggest any changes.

*Boletus innixus* also has many of the characters of *fulvus* or *tenuiculus*, and the dried specimens look a lot alike, although the spores of *innixus* are a little small and the surface is more fibrillose to possibly bunchy-fibrillose. This latter character suggests Frost's *Roxanae* [*Xerocomus Roxanae* (Frost) Snell, comb. nov.], although Frost thought they were different species, since

he published the two new descriptions in the same article, practically side by side.

*Boletus unicolor* was so named by Frost (in Peck) because it is yellow within and without. So also are *Suillus americanus* (Peck) Snell and *S. subaureus* (Peck) Snell. Peck distinguished *unicolor* from these two latter species by the absence of glandular dots on the stipe. He suggested a varietal relationship to *bovinus* but felt that the colors of the tubes and spores required a separation of the two. The dried specimens of *unicolor*, however, do show the presence of glandular dots on the stipe nearly to the base and to a certain extent on the tubes. This character would remove *unicolor* from any close relationship to *bovinus*, but from the description and the dried specimens, it is difficult to determine whether or not *unicolor* could be either of the Peckian species. The spores are nearest to those of *americanus* but the stipe is thicker than it ordinarily is for that species, except in rather large specimens. In deposit, the spores are given as reddish-yellow—obviously inaccurately, for a spore-print of this color would be very strange in the genus *Suillus* or any other genus of the Boleti but one, and even for Singer's new genus *Xanthoconium* (Peck's *B. affinis*, etc.) with spores in mass ferruginous-ochraceous, the term is nowhere near precise.

In view of the inadequacy and inaccuracies of description of *unicolor* and the difficulties mentioned, it at present appears neither possible to assign the epithet to synonymy nor desirable to maintain a third all-yellow species of *Suillus*. A satisfactory disposition of the name other than that of dubiety for the present will have to await the uncovering of further information.

On the other hand, another of Frost's species, *B. decorus*, cannot be correlated in any way with any other known species and even though it has not with certainty been identified by anyone since Frost, it must be considered as good until something resembling it can be collected or until other information is available.

#### BOLETINELLUS POROSUS

Murrill long ago changed the name of the familiar and easily identifiable *Boletinus porosus* (Berk.) Peck to *Boletinellus meruli-*

*oides*—a new genus for this somewhat odd species and the specific name of a *Daedalea* given by Schweinitz. The writer has been slow, perhaps unduly so, in accepting Murrill's combination until recent studies were completed. As noted previously (*Mycologia* 33: 421. 1941), Singer would place this species in *Gyrodon* and reduce *Boletinellus* to synonymy, but the writer prefers at least for the present to retain it. In any event, Schweinitz's specific name must be accepted in place of Berkeley's, which was likewise used by Peck. A few years ago, the Schweinitz Herbarium at Philadelphia was searched for odd items, and along with other interesting ones, a very small piece of what must be the type specimen of Schweinitz's *Daedalea merulioides* was found. There is very little left but a piece of the tube layer, but there is enough to provide an abundance of the spores that are entirely peculiar to this species. Therefore, *Boletinellus merulioides* (Schw.) Murrill replaces *Boletinus porosus* (Berk.) Peck.

#### BOLETUS POCONO SCHW.

Schweinitz described this species from specimens collected in beechwoods in the Pocono Mountains of Pennsylvania (*Synopsis Fungorum in America Boreali Media Degentium*. Trans. Am. Phil. Soc. II. 4: 314. 1832). The types are not available in Schweinitz's collection in the Academy of Natural Sciences in Philadelphia nor in the Michener collection in the Division of Mycology and Disease Survey at Washington. The original description is short and inadequate and apparently no one has ever been willing to make a guess as to what Schweinitz's species might be.

In the Michener collection, however, there is a specimen labelled by Michener as "*B. Pocono* ? N. Garden. C. Co. 1052 and 1063." "C. Co." means "Chester County." These specimens are in excellent condition and unquestionably are *Boletinus castanellus* Peck. There is no way of knowing whether Michener had any acquaintance with Schweinitz's *B. Pocono* which suggested this questionable identification of his fungus or if he merely made a tentative identification by means of the original brief description. At any rate, with Michener's lead it is easy to see that *B. Pocono*

might be what has long been known as *castanellus*. Even though there is no acceptable basis for a declaration of synonymy in this case, there is a certain amount of satisfaction in having some idea as to what Schweinitz's species might have been.

#### BOLETINUS PICTUS

Unfortunately it has fallen to my lot in my studies of the American Boleti to be compelled under the International Rules to make nomenclatural changes. Several changes have been particularly regrettable, since they have involved the abandonment of names known and applied for a long period of time by everyone in this country who has made collections of the group. The sort of change that I very much dislike to make, however, is to replace a very appropriate specific epithet with one that could be considered as nothing but a very poor one, the only virtue of which is its priority. And particularly the most painful duty is to replace an epithet not only of long standing but excellent in that it is accurately descriptive or has a pleasing flavor, even something of poetry in certain instances, with one that was manufactured as the genitive of the name of an individual. To me this practice is an abominable habit and has nothing to recommend it. I am happy that in one particular case the original discomfiture fortunately proved to have no foundation.

Everyone who has ever known any of the Boleti has been familiar with the common and beautiful *Boletinus pictus* Peck under our eastern (or northern) white pine. No one has questioned the validity of Peck's name, although privately the writer came to do so because of what seemed to be the plain and incontrovertible facts. Peck considered *B. Spraguei* B. & C. (Bull. N. Y. State Mus., vol. 2, no. 8, September, 1889, p. 77), and others have considered *B. Murrai* B. & C., to be the same. These two species of Berkeley and Curtis were published in Grevillea, vol. I, 1872, the September issue, pages 35 and 36, respectively. The description of *B. pictus* appeared on page 128 of the "Twenty-third Annual Report of the Regents of the University of the State of New York, on the Condition of the State Cabinet of Natural History," etc., which is usually abbreviated to read "Ann. Rep. N. Y. State Cab.," and the

commonly accepted date of publication has been 1872. On the other hand, as I looked up this publication in my own set of Peck's Reports, I found that the "Report of the Botanist" is signed on page 135 "Chas. H. Peck, Albany, January 8, 1870" and on the title page of the volume it is stated that the Report of the Regents was transmitted to the Legislature on March 10, 1870, but at the bottom of the title page, the printer's date is given as 1873. Accordingly, the situation seemed to be that the epithet *pictus* had been published in 1873 even though Peck had submitted the Report containing it in 1870, that the epithets *Spraguei* and *Murrai* had been published in September, 1872, and that even though Peck later had considered *Spraguei* a synonym of *pictus*, there was no alternative but to abandon the name *pictus* in favor of either *Spraguei* or *Murrai*—both repugnant, if not abhorrent.

Donald P. Rogers one day, however, called to my attention the presence of a discussion by Farlow on a shelf in the Farlow Herbarium of the varied manner in which Peck's Reports appeared, under various guises and with different datings. It was found that the copy of Peck's Report 23 for 1869 at Cambridge containing the description of *pictus* bears the date 1872. Then Homer D. House reported that after failing to get any satisfactory results from examination of official files, he looked at Peck's own set of Reports. Here he found that on Appendix C, "Report of the Botanist," it was stated "Printed in Advance of the Report" and that this advance printing of Appendix C is dated 1872. Further, the title page of Peck's copy of his Report has a date stamp on it which states that the printed copy was received in his office on March 23, 1872.

Therefore, it is obvious that the copy of Report 23 in my possession is the complete Report 23 of the Regents and that the advance printing of Appendix C, Peck's Report, establishes the priority of the publication of the description of *Boletinus pictus* over the epithets published in the September issue of Grevillea.

#### YELLOW-BROWN HYMENIAL BODIES

Yellow-brown bodies have been found in greater or lesser abundance in the hymenium of fruit bodies of the following species of

Boleti—*Suillus hirtellus* (Peck) Kuntze, *Xerocomus badius* and its variety *limatulus*, *Boletus griseus* Frost, *B. decorus* Frost (type specimen), *Tylopilus alboater* (Schw.) Murr., *T. indecisus* (Peck) Murr., and *T. plumbeoviolaceus* Snell & Dick. These have varied in size from what one would call ordinary-sized hymenial bodies, as compared with cystidia, etc., to quite large ones. They have varied in shape from spherical to oblong-elliptical to broadly fusoid or fusoid-ovoid to all sorts of modifications of these shapes to very irregular, if not almost amorphous in some cases. The first such bodies noticed were very irregular in shape and it was supposed that they were resinous residues of some sort, possibly resulting from the drying of fluids from lactifers or similar structures. They were found, however, to be insoluble in ordinary solvents. Then it was found that in certain species at least these bodies were mostly regular in shape—spherical or oval for the most part—and the more regular ones appeared to have a thick wall. These are still very puzzling and one cannot say with any assurance what their origin and nature may be, but in some mounts of tube-tissues can be found what appear to be stages in their formation and development. Figure 1 shows an arbitrary arrangement of structures found in a single mount. From left to right are represented a mature, ventricose-rostrate, hyaline cystidium ("lageniform" to the Europeans), one becoming yellow, the closing-off of the deep yellow-brown ventral body, the loss of turgidity of the hyaline neck, and finally some of the more regular dark yellow-brown bodies without any remains of the cystidial wall.

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## NOTES AND BRIEF ARTICLES

### A CORRECTION

In the article "New and heretofore unreported species of the higher Ascomycetes from Colombia and Venezuela," published in *Mycologia* 36: 429-459. 1944, on page 437, line 9, a serious omission occurs between "bifurcated (branches 9-12)." . . . and . . . "A new collection was made by the author . . . etc." The corrected version should read:

. . . bifurcated (branches 9-12  $\mu$  long). The perithecia are 125  $\mu$  in diameter, collapsing. The ascospores are 4-septate, elliptical with blunt ends and slightly constricted at the septa, measuring 32-34  $\times$  12-13  $\mu$ .

This species differs from *M. Psychotriae* Earle in having some of the setae bifurcated and from *M. anceps* Syd. and from *M. anceps* var. *Mussaendae* (Syd.) Stev. in the character of the setae, many of which, in this material, are dark in their total length without having a pellucid tip. Other minor differences in the aspect of the mycelium and the hyphopodia are apparent when the specimen is compared with *M. Psychotriae* Earle (FV 306 and 372) and with *M. anceps* var. *Mussaendae* (CUPP 32821 and 32907 from the Philippine Islands). The specimen is rather poor, many colonies being overrun by *Trichopeltaceous* and *Meliocolous* parasites.

#### **Meliola Obtusa** (Toro) comb. nov.

*Irenina obtusa* Toro. Journ. Dept. Agric. Porto Rico 14: 236. 1930. On *Tontanea canascens* (Willd) Stand.

COLOMBIA, Antioquia, Road Medellin-Las Palmas, 2000 m., Garcés et al., Mar. 31, 1942. FC 1661, Med. 408.

A study of the type specimen (Toro FC 221) discloses the presence of mycelial and perithecial setae, and consequently the species must be transferred to the genus *Meliola*. A new collection made by the author . . . etc.

The above error was due to the omission of one whole page in the manuscript sent to the press. The author's copy of the manuscript also lacked this page and the mistake unfortunately occurred at a point in the paper difficult to detect from the sense of the words alone; it was thus overlooked when the galley proof was checked.

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MRS. G. MILLER

The retirement of Mrs. Miller from The New York Botanical Garden, for a domestic career, after nearly twenty years of service, is a great loss to MYCOLOGIA and to the Mycological Society of America. Even before the organization of the Society she was virtually an assistant editor. Among other things she, under the supervision of the writer, compiled the twenty-four year index to MYCOLOGIA, which has been found so useful to mycologists.

She is familiar with every step in the organization of the Mycological Society and its affiliation with The New York Botanical Garden, and personally acquainted with the many mycologists who have called at The New York Botanical Garden, during the past years. Since the organization of the Society, she has continued to act as assistant in both editorial and managerial matters. Her great care and insight into the financial details has "stopped many a leak," and saved much money both for the Mycological Society, and for The New York Botanical Garden.

On behalf of the Mycological Society of America our best wishes are extended to her for the future.—FRED J. SEAVER.

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PATHOLOGY IN FOREST PRACTICE

This volume by Dow V. Baxter, Associate Professor of Silvics and Forest Pathology in the School of Forestry and Conservation in the University of Michigan, has recently appeared.

While the book is intended for use by the practical forester, it will be of interest to mycologists as well since considerable space is devoted to fungi destructive to forest trees.

The volume published by John Wiley & Sons is put up in the usual substantial form. It comprises i-xi + 618 pages and 232 figures. The illustrations are unusually good. A more detailed account of this work by Perley Spaulding may be found in the *Journal of The New York Botanical Garden* for December 1944.

—FRED J. SEAVER.

